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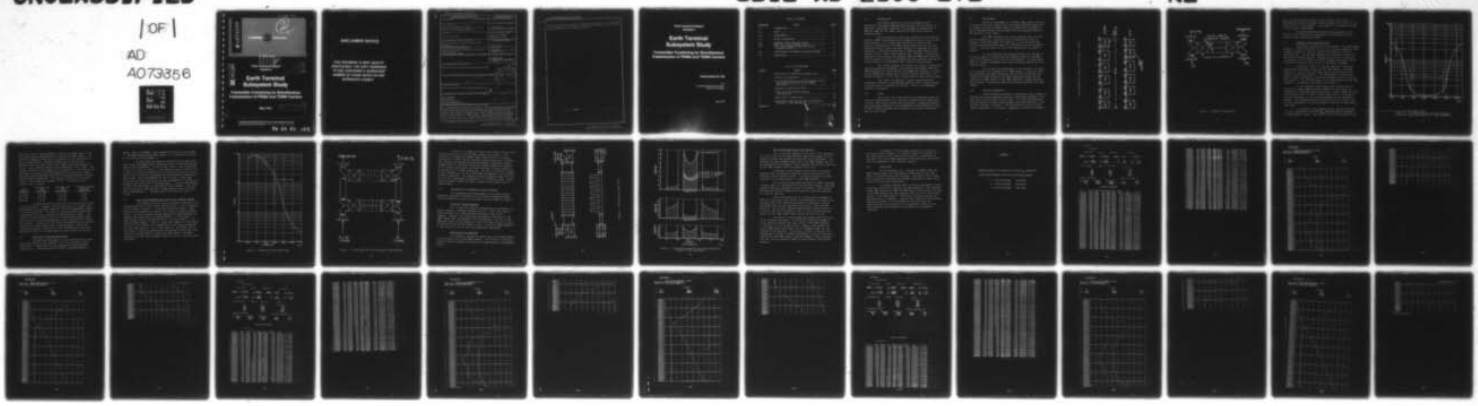

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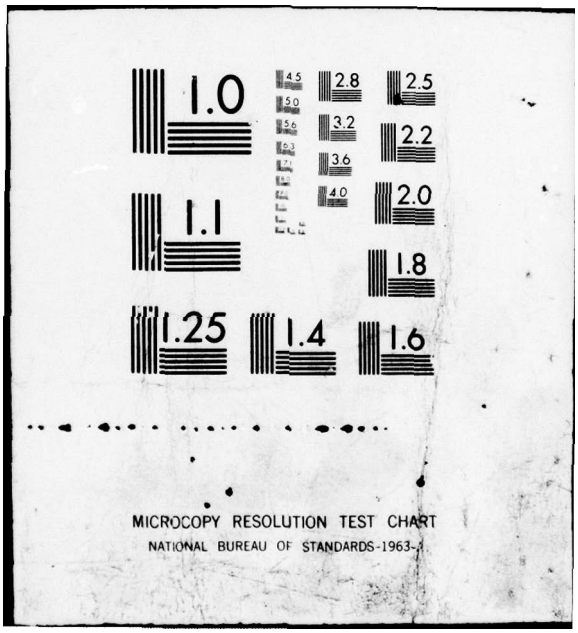
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Final Technical Report
Volume 4

Earth Terminal Subsystem Study

Transmitter Combining for Simultaneous Transmission of FDMA and TDMA Carriers

May 1979

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This report addresses alternative methods of combining high-power TDMA and FDMA X-band carriers for simultaneous transmission from Defense Satellite Communications System (DSCS) earth terminals. The TDMA signal is assumed to be in Channel 1 of the DSCS III frequency plan, with the FDMA carriers in Channels 2 and 6 (on both sides of the TDMA signal). Three alternative diplexer configurations are described: (1) a conventional bandpass filter; (2) a band-stop filter; and (3) a dual E-stub filter. The three configurations are evaluated

(over)

in terms of insertion loss, phase linearity, and complexity. It is concluded that the bandpass filter approach is the preferred approach, based on its low-loss characteristics and its design simplicity.

Final Technical Report
Volume 4

Earth Terminal Subsystem Study

Transmitter Combining for Simultaneous Transmission of FDMA and TDMA Carriers

Subcontract S-165

For
Computer Sciences Corporation
Falls Church, Virginia

May 1979

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LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

This report describes the work performed by Harris Corporation, Government Communications Systems Division (GCSD), on Subtask 4, Transmitter Combining for Simultaneous Transmission of FDMA and TDMA carriers under Subcontract S-165, Earth Terminal Subsystem Study.

The introduction of TDMA into the DSCS will mean that CW carriers (FDMA) and pulsed carriers (TDMA) must co-exist in the same earth terminal. If a common power amplifier is used for both carriers, degradation of the FDMA signals would occur due to cross-modulation effects unless the power amplifier is operated far below saturation. Efficient transmission of FDMA and TDMA signals simultaneously from a single earth terminal will, therefore, require the combining of the outputs from separate FDMA and TDMA power amplifiers. No such capability exists in the AN/FSC-78 (HT) terminals and none is being provided in the AN/MSC-61 (MT) terminals being procured.

This report presents the results of a study of alternative diplexing/combining approaches for achieving simultaneous FDMA and TDMA transmissions in the AN/FSC-78 and AN/MSC-61 terminals. Because of the commonality between the HT and MT terminal electronics, all efforts addressed in this study are applicable to both terminal types.

This report is organized to define requirements and assumptions relative to the diplexer/combiner; this is then followed by an evaluation of alternative designs. Finally, a recommended approach is presented.

2.0 SCOPE

The scope of the study effort to be performed under this task is limited primarily to a review of previous Harris experience in filter and diplexer design and construction. Design and fabrication experience obtained in the development of the diplexers for the MT and LT antenna systems will be used as the primary information base for this study.

3.0 REQUIREMENTS

The basic requirement is to diplex FDMA signals from the existing TWT HPA with signals from a new TDMA transmitter which will be located in the RF Equipment Room of the AN/FSC-78 or AN/MSC-61. The RF Equipment Room of both terminals can be considered identical for purposes of this study.

The TDMA transmitter will have an output power of 5 kW and will operate at a 10% duty cycle at a 60 MHz burst rate in Channel 1 of the DSCS Phase III Satellite. The existing TWT HPA will be transmitting FDMA signals in a 40 MHz band in both Channels 2 and 6. The DSCS Phase III satellite frequency plan is shown in Figure 1.

It is assumed that the TDMA transmitter will operate at full peak power of 5 kW and that the composite power of the FDMA carriers in Channels 2 and 6 will be 2 kW maximum. It is desirable that all diplexer components have a power handling capability of at least 10 kW CW.

The criteria for performance of the diplexer is to minimize insertion loss, especially for FDMA signals. To prevent interaction between the TDMA transmitter and the existing TWT HPA, the rejection of TDMA signals at the FDMA transmitter output and the rejection of FDMA signals at the TDMA transmitter output should be 20 dB minimum. Group delay should be minimized especially for TDMA signals.

4.0 DESIGN ALTERNATIVES

Three alternative diplexer configurations were studied to perform the channel combining function; conventional bandpass filter, band stop filter and dual E-stub filter. All three configurations use two identical filters placed between short-slot hybrids of 3 dB couplers as shown in Figure 2. The functioning of such a filter/hybrid combination is as follows: frequency F_1 enters port number 2

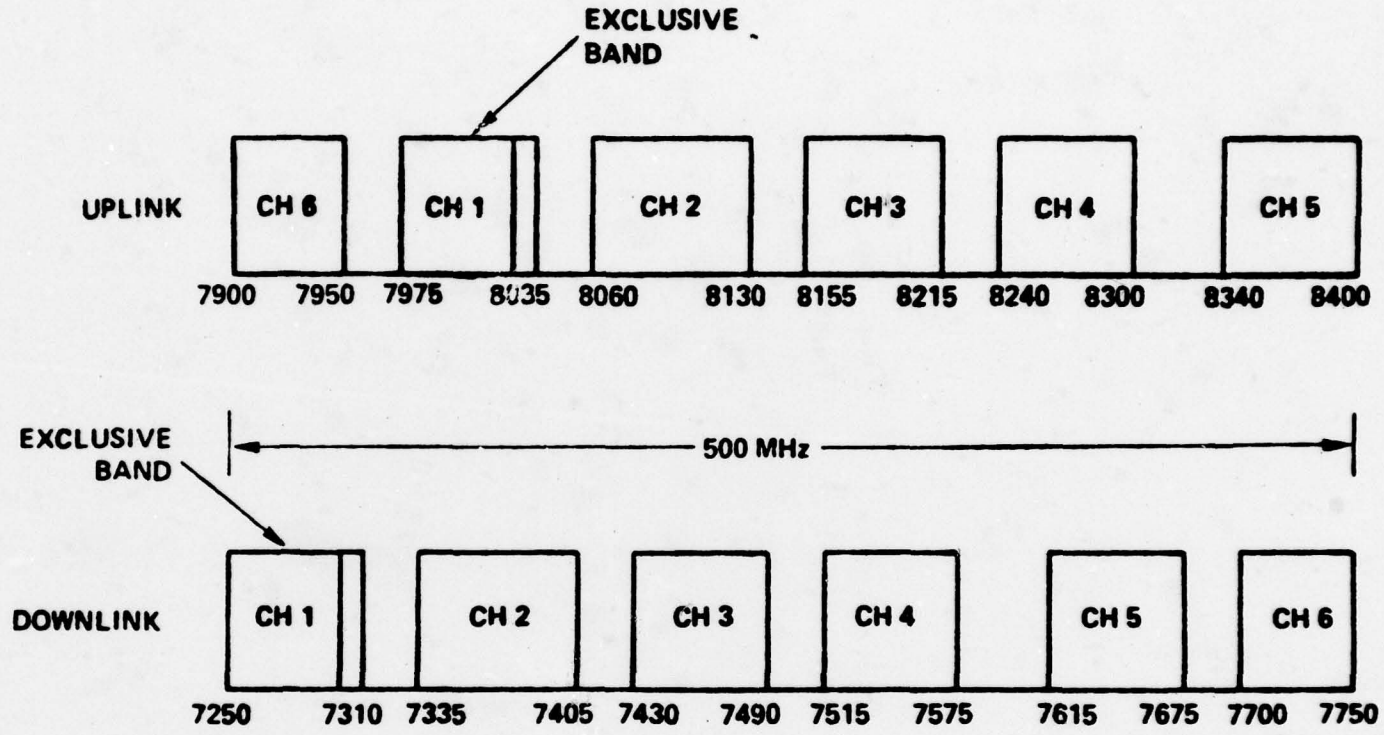

Figure 1. DSCS Phase III Satellite Frequency Plan

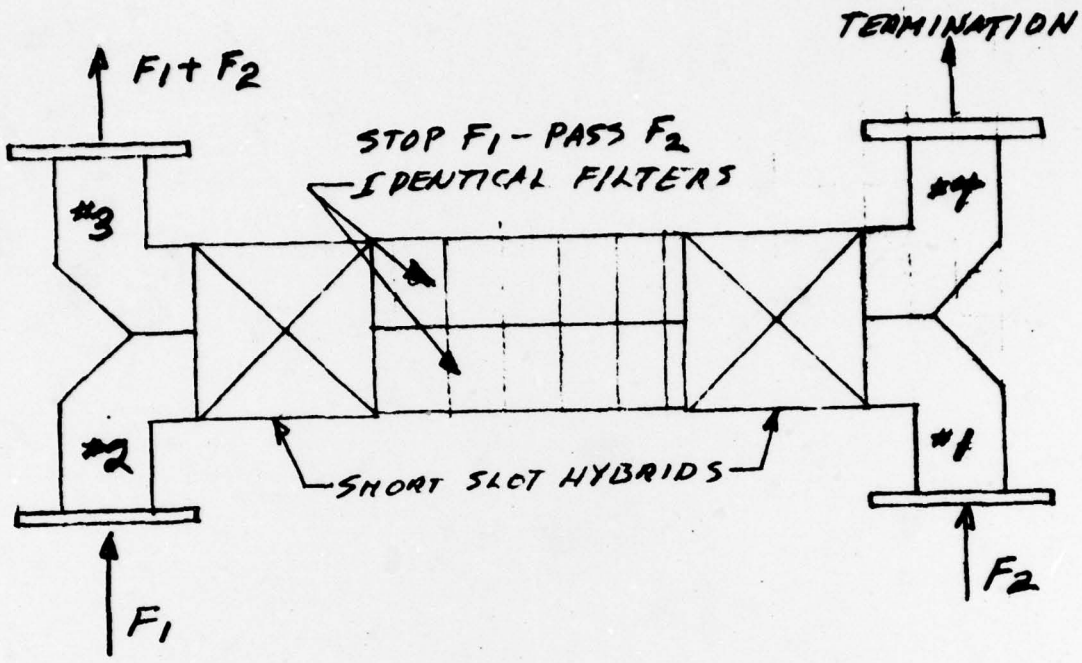

Figure 2. Diplexer Configuration

and is totally reflected by the filters and exits port number 3. Frequency F_2 enters port number 1 passes through the filters and combines with F_1 at port number 3. Port number 4 is isolated from both F_1 and F_2 and is terminated.

The three alternative diplexer configuration, all of which use the filter/hybrid arrangement described above, are discussed in the following paragraphs.

4.1 Bandpass Filter Diplexer Design

Three bands (channels) must be combined. The TDMA channel, Channel 1, 7.975 to 8.035 GHz (F_T) is to be inserted between two FDMA channels, Channel 6, 7.900 to 7.950 GHz and Channel 2, 8.060 to 8.130 GHz (F_H). The two FDMA channels are the output from the TWT HPA and are already combined. Although not given as a constraint for purposes of this study, the uplink frequency band above Channel 2 (8.130 to 8.400 GHz) should also be considered a bandpass.

Referring to Figure 2, the two identical filters are constructed as bandpass filters for the TDMA channel. The FDMA channels, F_L and F_H enter port number 2 and are reflected by the filters and exit port number 3. The TDMA channel F_T enters port number 1 passes through the filters and combines with F_L and F_H at port number 3. The combined output of the TDMA channel and the FDMA channels, is therefore, available at port number 3.

If the bandpass filters were direct coupled and built with WR 137 copper waveguide using symmetrical vane irises, an unloaded Q of about 8000 might be obtained. Figure 3 shows the bandpass characteristics of such a filter consisting of five poles to provide a minimum of 20 dB isolation between the two transmitter outputs. The complete combiner losses would be very low (0.1 dB) for the FDMA channels but would approach 2.0 dB at the TDMA channel band edges.

A variation of this bandpass filter design consisting of high Q cyclindrical cavities (TE_{011} mode provides an unloaded Q of approximately 18,000. The insertion loss of the diplexer using

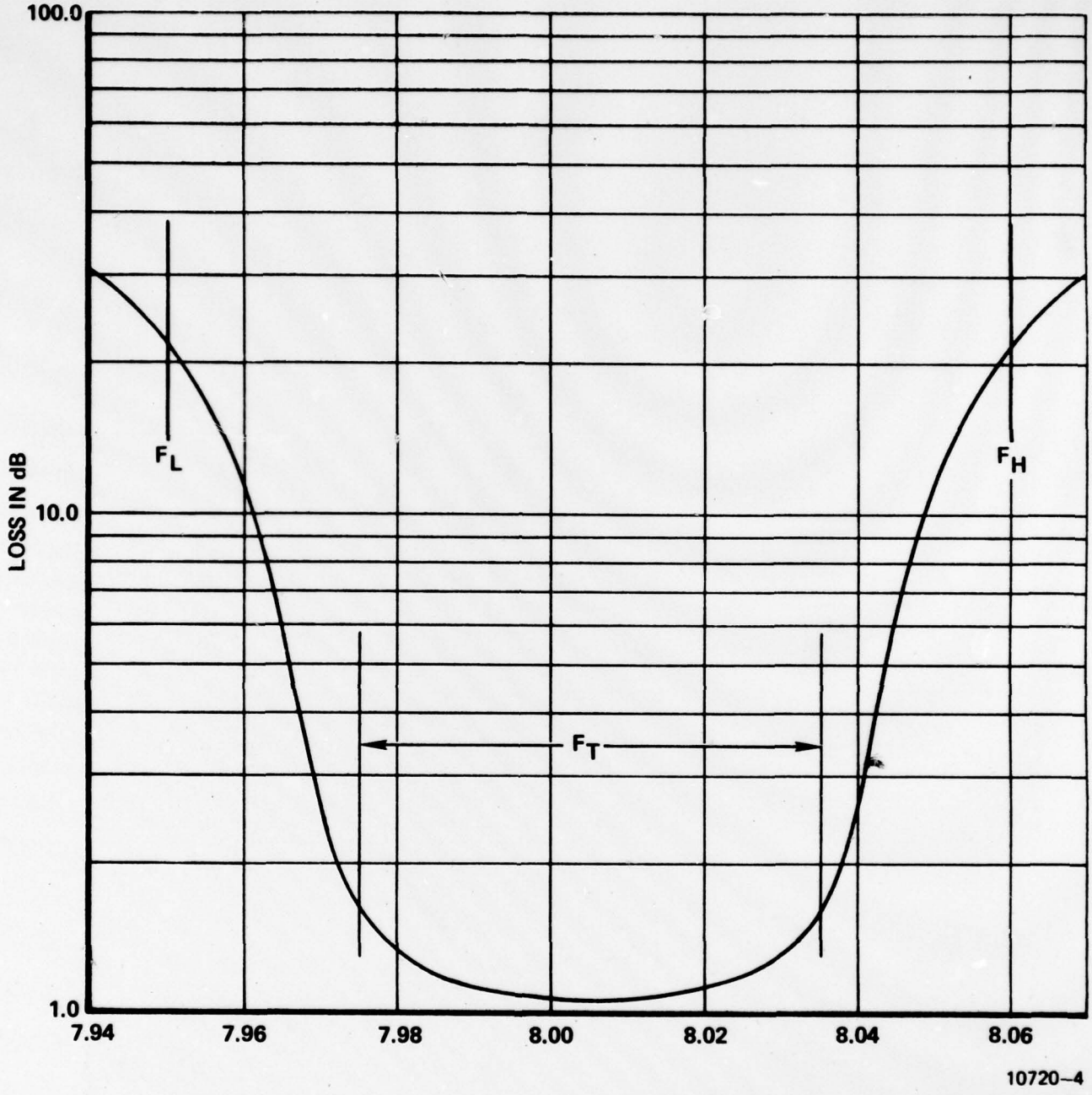

Figure 3. Loss Characteristics of 5-Pole Bandpass Filter when Constructed with WR 137 Copper Waveguide

this type filter is approximately 0.7 dB for the TDMA signal at the band edges and has approximately 0.1 dB loss for FDMA signals. The design of bandpass filters such as required for this application is very straightforward. Computer programs exist to accurately determine insertion loss, return loss (VSWR), and phase characteristics. Such a computer analysis was performed for this filter. The results are shown in the computer run in Appendix A. The analysis was performed using three different bandwidths to determine the lowest loss that could be obtained while still providing adequate isolation between FDMA and TDMA bands. The design is based on a five cavity 0.04 dB ripple Chebyschef bandpass filter. The results of the analysis are as follows:

TDMA Bandwidth	Insertion Loss TDMA Band Edges	Insertion Loss TDMA Band Center	Isolation Between TDMA and FDMA Ports
62.0 MHz	0.82 dB	0.55 dB	25 dB
64.0 MHz	0.77 dB	0.50 dB	23 dB
66.0 MHz	0.70 dB	0.46 dB	21 dB

The widest filter (66 MHz) also provides the least isolation between ports. However, the isolation was still greater than the minimum 20 dB required, therefore, the 66 MHz bandwidth appeared to be the best choice. The effect of reflecting FDMA signals from a nonperfect short was a concern for QPSK modulated signals. The nonperfect short manifests itself as an amplitude and phase characteristic which can cause degradation of the orthogonality of quadrature signals. Inspection of the reflection coefficient and angle of reflection has shown these values to be negligible. Hence, the 66 MHz wide bandpass filter used in this configuration should have negligible effect on the FDMA channels except for the 0.1 dB loss.

4.2 Band Stop Filter Diplexer Design

The FDMA and TDMA channels can be combined using a band stop filter design in the diplexer. For such a diplexer a band stop filter is substituted for the bandpass filter described in Paragraph 4.1. Referring again to Figure 2 the FDMA channels, F_L

and F_H, enter port number 1 pass through the filters to port number 3. The TDMA channel enters port number 2, is reflected by the band stop filters into port number 3.

No calculated loss data is available for the exact band-stop filter requirement, but a band-stop filter of the same type was used in the HT terminals. A plot of this filter's loss as measured at Harris is shown in Figure 4. The rejection slope of the HT filter is about half of that required for this application since the guard band is only 25 MHz and the passband to 20 dB stop-band separation is only 42 MHz. The stop bandwidth of the HT filter is also about twice that required. Narrowing the stop bandwidth will increase the passband loss, especially at the band edges. A loss of approximately 0.7 dB at the band edges is predicted for this approach. This band edge loss occurs at the high end of FDMA Channel 6 and at the low end of FDMA Channel 2. The TDMA channel loss would be close to 0.1 dB.

4.3 Dual E-Stub Wideband Band Stop Filter Diplexer Design

The combining function can be performed using dual E-stub wideband band stop filters in the diplexer design. Such a configuration is shown in Figure 5. It uses two diplexer sections. Each section uses broadband band stop E-stub filters to reduce passband losses. The first diplexer section separates the FDMA channels and combines the TDMA channel with FDMA Channel 6 in port number 3. FDMA Channel 2 passes through the filter into port number 4. The TDMA and FDMA Channels, F_T and F_L, enter port number 6 in the second section of the diplexer, pass through the filters and are combined with the FDMA Channel 2, F_H, in port number 8, the output port of the network. With this configuration the channel nearest the filter stop band (passband edge) is always the TDMA signal. The FDMA channels are either the reflected signals or are far from the filter band edges.

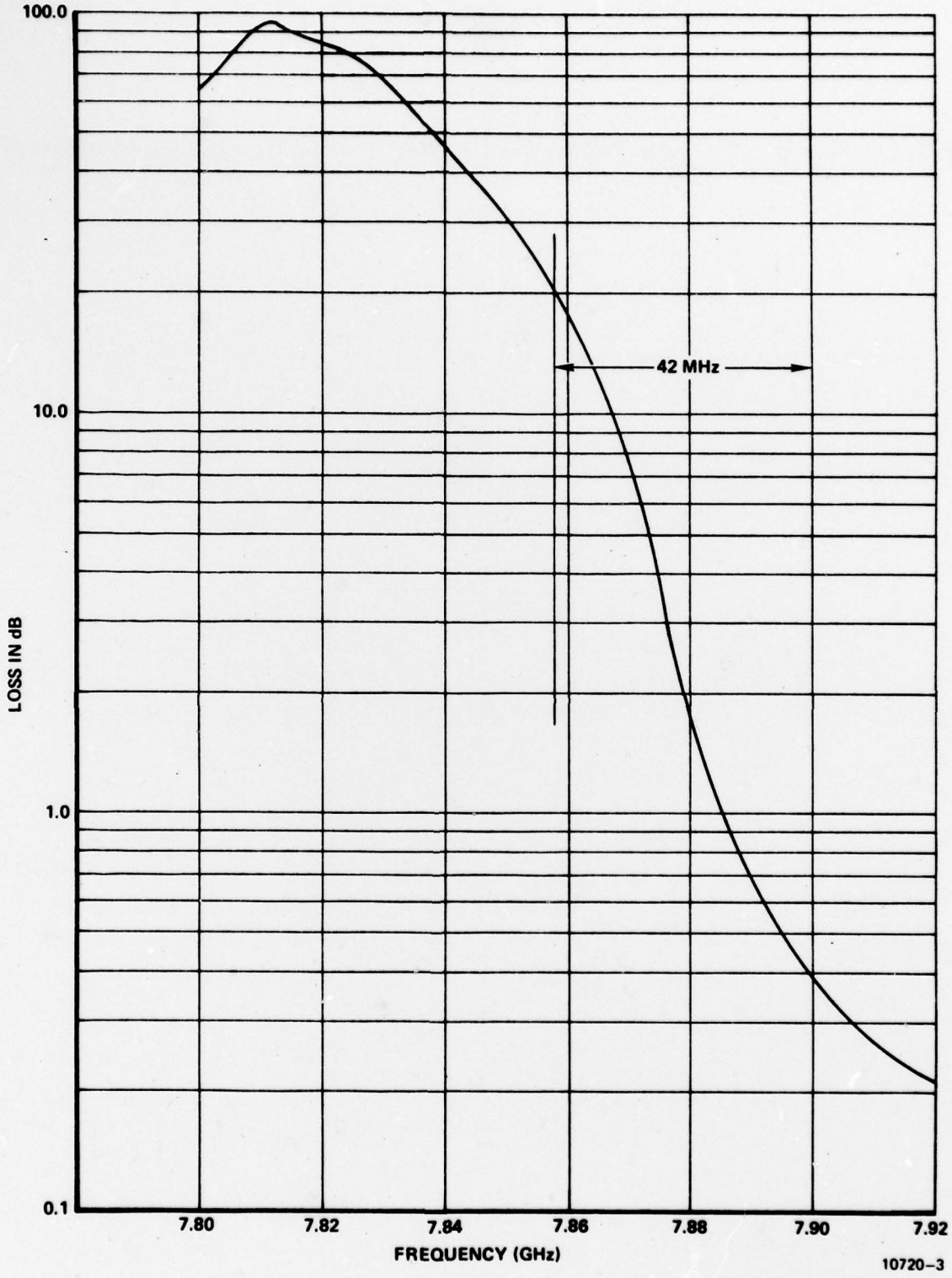

Figure 4. Response of Band Stop Filter

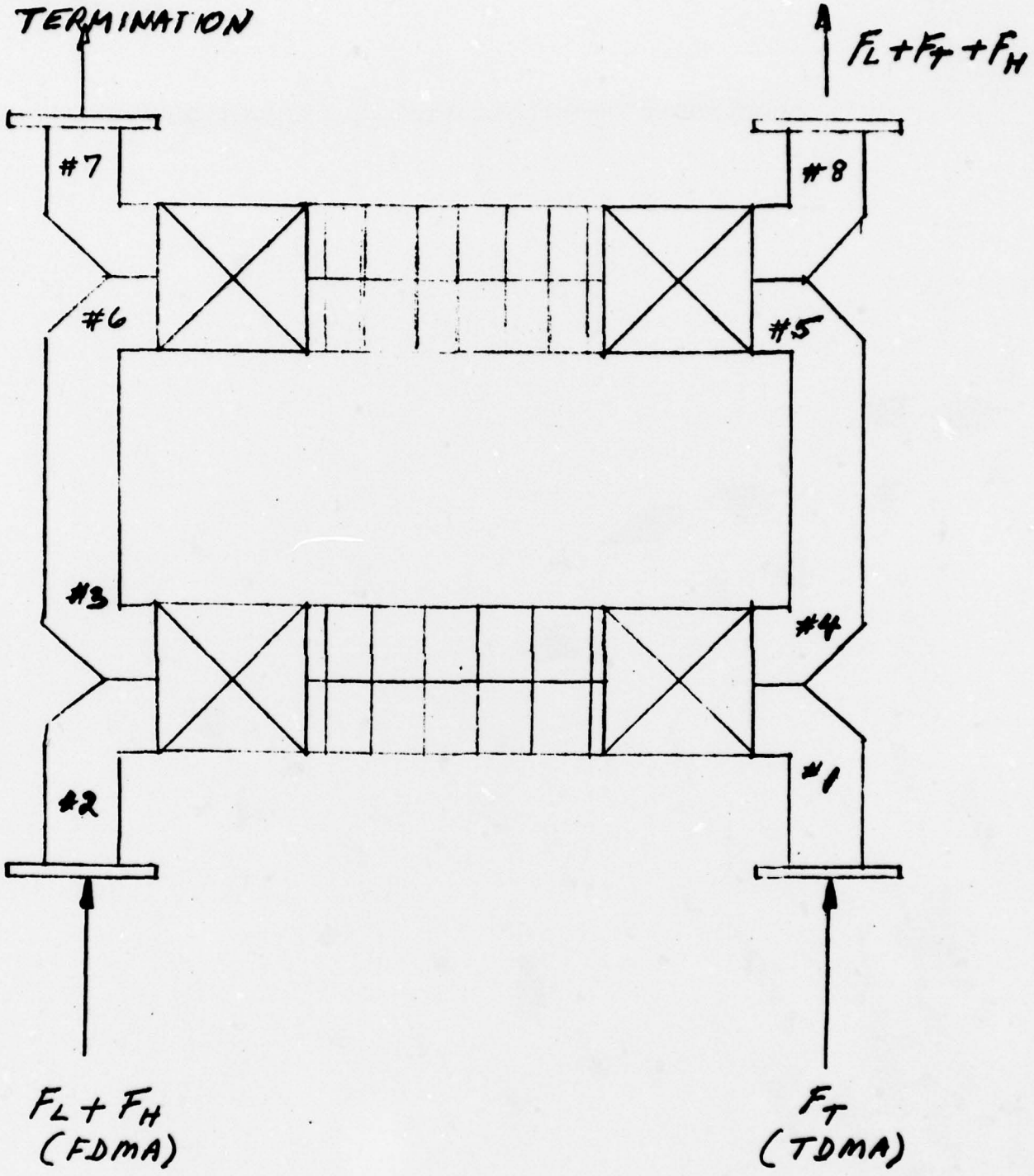

Figure 5. E-Stub Band Stop Filter Diplexer Configuration

Figure 6 is a sketch of a dual seven cavity, E-stub filter configuration used in an MT antenna diplexer application. This diplexer was designed to combine signal channels with a frequency separation of 50 MHz with an isolation greater than 60 dB. Although this diplexer was designed for 50 MHz frequency separation between channels which is twice the 25 MHz guard bands between the channels in the present application, test data indicated it would provide 25 dB isolation for a 25 MHz separation. The loss for reflected signals in this diplexer was 0.2 dB at band edge and dropped to 0.1 dB within 20 MHz of band edge. For signals passing through the filter the loss was 0.4 dB at band edge and dropped to 0.1 dB within 30 MHz. Losses could be reduced further by using a sharper cutoff (more stubs or longer stubs).

5.0 EVALUATION OF ALTERNATIVE DIPLEXER DESIGNS

The advantages and disadvantages of the three diplexer approaches discussed in Section 4.0 are briefing summarized below. The calculated loss curves for the three cases are shown in Figure 7.

Band Pass Filter Approach

This is the most simple, straightforward, and lowest risk design approach. Computer programs exist for almost exact design. Highly accurate loss, VSWR and phase characteristics can be computed. However, this design has unacceptably high losses in the TDMA channel when implemented in WR 137 waveguide. The loss at the TDMA band center can be reduced to 0.5 dB or slightly less if a TE_{011} cylindrical cavity design filter is used. The loss to FDMA channels is the lowest (0.1 dB) of the three approaches considered.

Band Stop Filter Approach

This approach provides the lowest loss to the TDMA channel but the highest loss to the FDMA channels. This filter is relatively simple in design although not quite as straightforward as the bandpass design.

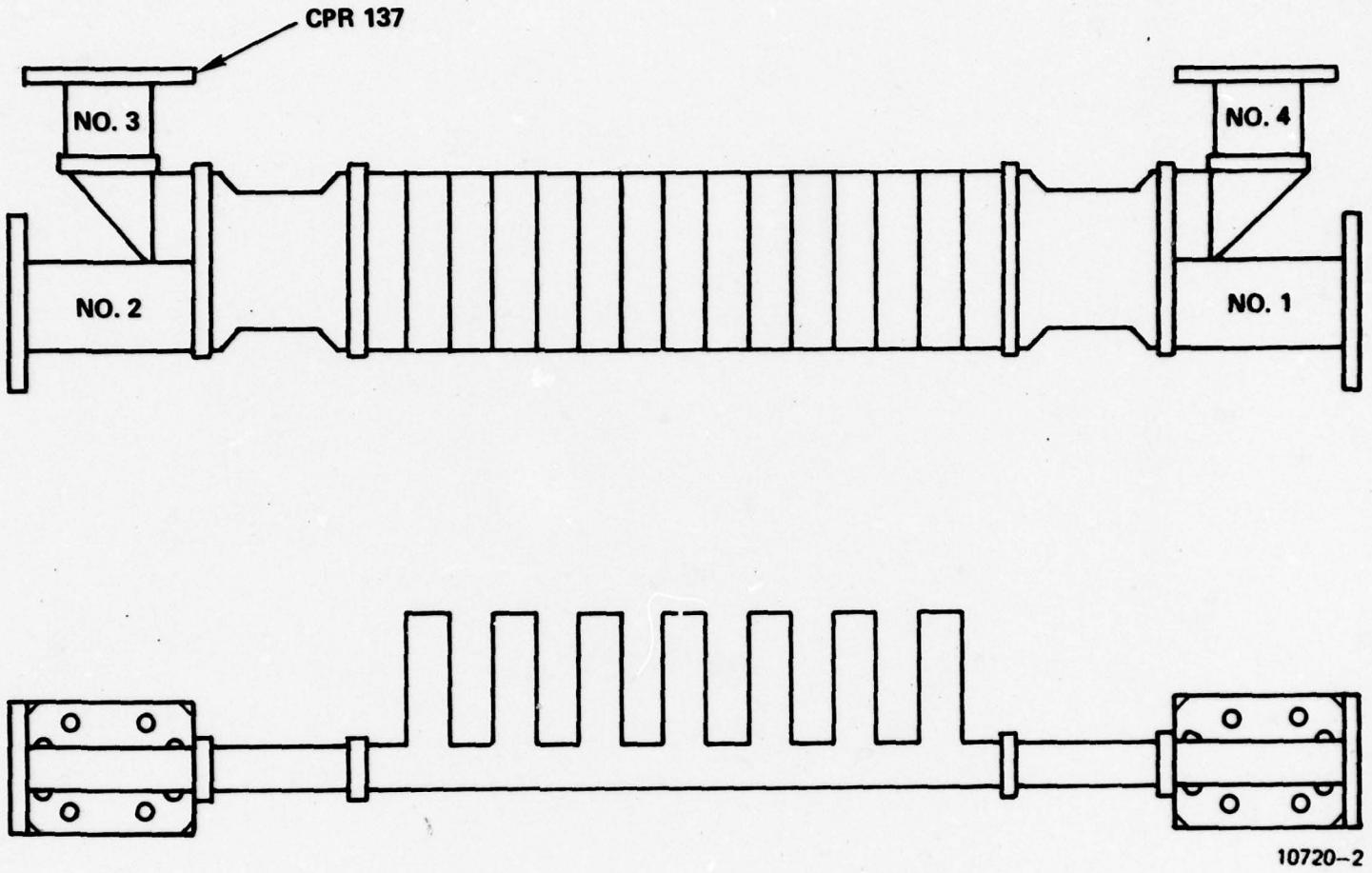

Figure 6. Seven Cavity E-Stub Filter

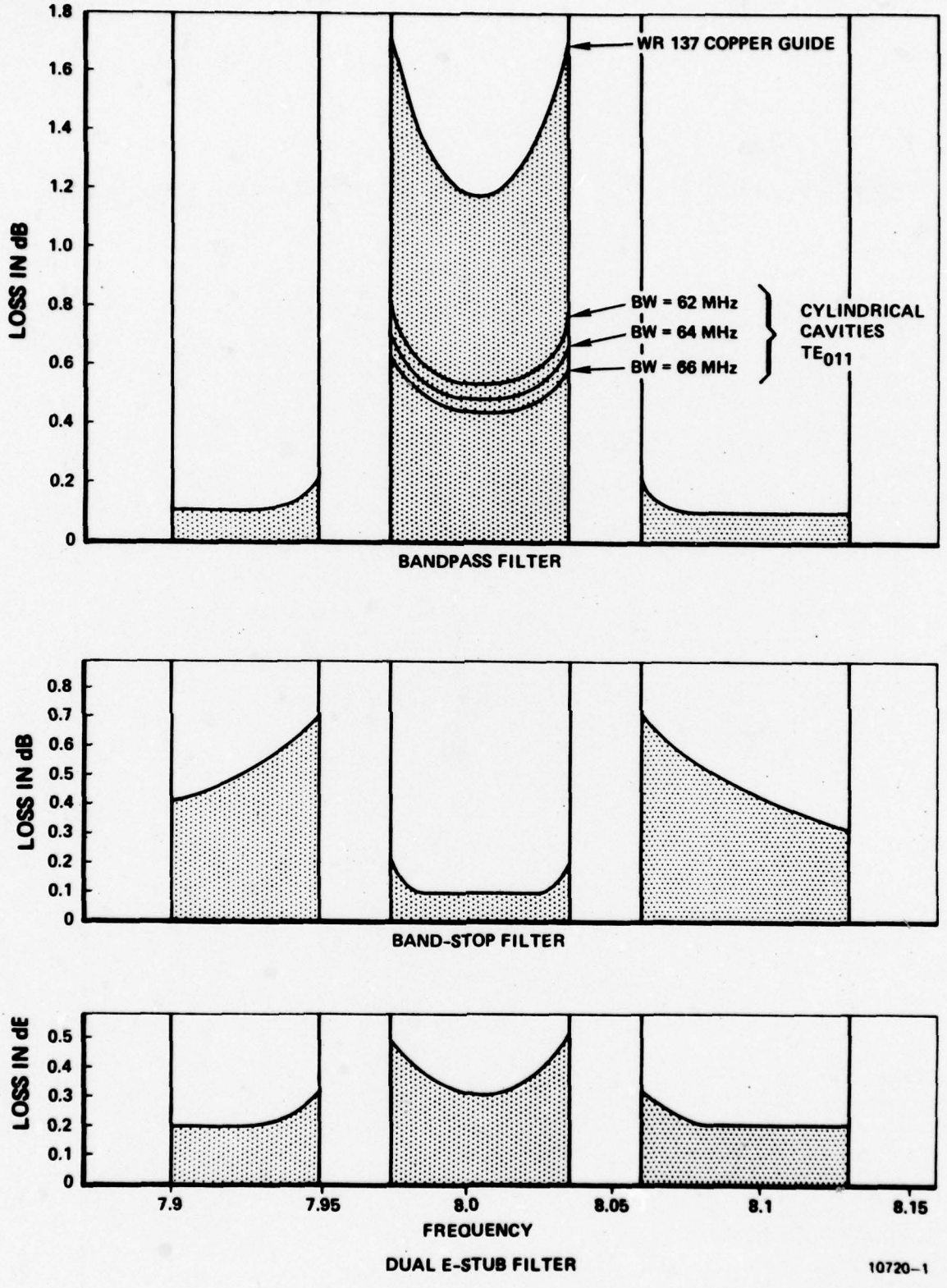

Figure 7. Calculated Losses for the Three Alternative Diplexer Filter Approaches

Dual E-Stub Band Stop Filter Approach

This is the most complex of the three filter approaches. Two filter sections are required which doubles the number of components and more than doubles the diplexer space requirement. This approach provides somewhat lower loss to the TDMA channel than can be achieved with the bandpass filter approach and provides lower loss to the FDMA channels than the bandstop filter case.

In making a final tradeoff on the choice of diplexer approach some consideration should be given to the weight to be given the various channel losses. Is achieving lower losses more important in the TDMA channel or in the FDMA channels?

For the application being considered, a TDMA transmitter is being added as a modification to an existing terminal. Non-TDMA channels should be degraded as little as possible. Specifically, the terminal EIRP and therefore AJ capability should be impacted as little as possible.

After considering the loss calculations presented in Figure 6, along with other factors discussed above, it appears that the band stop filter approach discussed in Paragraph 4.2 can be eliminated based on the relatively high losses in the non-TDMA channels. This diplexer approach would present minimum losses of 0.3 to 0.4 dB for all portions of the 7.9 to 8.4 GHz uplink band except for the TDMA channel where losses would be very low.

The choice is then between the bandpass and the E-stub filter diplexer approaches. As previously stated the bandpass filter approach provides the least losses to non-TDMA channels, 0.1 dB versus 0.2 dB minimum losses. However, the minimum loss at the TDMA channel band center will be somewhat higher for the bandpass filter approach. Using TE_{011} cylindrical cavities with a bandwidth of 66 MHz a minimum loss between 0.4 and 0.5 dB can be achieved for the TDMA channel using the bandpass filter approach. This loss can be reduced to about 0.3 dB using the E-stub filter approach.

The bandpass filter diplexer approach is chosen over the E-stub filter approach. The slightly lower loss provided to the TDMA channel by the E-stub filter approach is outweighed by the lower loss in non-TDMA bands and by the simplicity, and smaller size of the bandpass filter diplexer approach.

6.0 CONCLUSIONS

Design approaches for a diplexer to combine FDMA and TDMA channel signals for simultaneous transmission in the DSCS Phase III Satellite have been evaluated. The scope of this study task limited the evaluation to diplexer approaches for which Harris has had previous design experience.

A diplexer approach based on the use of bandpass filters using TE_{011} cylindrical cavities has been presented. This approach allows the combining of FDMA and TDMA signals with low loss (0.1 dB) to non-TDMA channels and only moderate loss (0.4 to 0.5 dB at band center) to the TDMA channel. The effects on phase linearity are negligible for all channels. Based on the simplicity of the design approach presented it is concluded that the costs and risk associated with the diplexer will be negligible factors in any TDMA transmitter modifications to the AN/FSC-78 or AN/MSC-61 terminals.

APPENDIX A

Computer analysis for a cylindrical 5-cavity TE_{011} Tchebyscheff 0.04 dB ripple bandpass filter for the following passbands:

1. 7.973 to 8.037 GHz BW= 64 MHz
2. 7.972 to 8.038 GHz BW= 66 MHz
3. 7.974 to 8.036 GHz BW= 62 MHz

FILTER DESIGN

LOCK YOUNG FILTER

.0400 DB LOSS POINT   5 CAVITIES   .04000 DB RIPPLE   TCHEBYSCHEFF FILTER

ORIGINAL	F1 = 7973.00000	F2 = 8037.00000	BANDWIDTH =	64.00000	FO = 8004.79419		
CORRECTED	F1 = 7973.00000	F2 = 8037.00000	BANDWIDTH =	64.00000	FC = 4301.53165		

A =	1.37200	B =	.62200000	T =	.05000	E =	1.00000
GJ =	18000.00000	R =	1.00000000	M =	.02400	CLS =	.00500
OMEGA-PR =	1.00000	DTOL =	.00500000	LO =	0.00000	RHO =	0.00000

DESIGN CHARACTERISTICS   LAMDA-G0/4 = .437081 INCHES = 1.110187 CM.

G	B	CAVITY LENGTH (CL)
.0177	7.2287	.83232
.9576	69.8643	.86674
1.3704	86.6318	.86789
1.7075	86.6318	.86674
1.3704	69.8643	.83232
.9576	7.2287	0.00000
.0177	0.0000	0.00000

PRACTICAL DESIGN DIMENSIONS   SUSCEPTANCE FOR THE SYMMETRIC VANE.

CAVITY LENGTH (CL)	GAP WIDTH (D)	SUSCEPTANCE (B)	B1	DELTA L
.86319	.3095246	7.27110	27.01207	.01000
.90401	.1854153	68.17898	67.41765	.00415
.90568	.1671902	86.39676	77.21903	.00360

FILTER DESIGN - ANALYSIS OUTPUT

FREQUENCY	INSERTION LOSS	INSERTION PHASE	GAMMA(DB)	ABS VALUE OF GAMMA	ANGLE OF GAMMA	STANDING WAVE RATIO	GROUP DELAY(NS)	DISPERSION
.79400000E+01	32.2019	352.8050	-.0866	.990069	100.08620	99.0000	.37616065E+01	-.13994620E+02
.79410000E+01	31.4186	354.1900	-.0913	.989545	98.68382	99.0000	.39346705E+01	-.13621755E+02
.79420000E+01	30.6198	355.6396	-.0965	.988952	97.29997	99.0000	.41208545E+01	-.13655574E+02
.79430000E+01	29.8044	357.1508	-.1023	.988296	95.84999	99.0000	.43222616E+01	-.13454167E+02
.79440000E+01	28.9715	358.7557	-.1087	.987565	94.32826	99.0000	.45416306E+01	-.13215599E+02
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.79510000E+01	22.5773	372.7097	-.1858	.978683	81.02813	93.4654	.67897424E+01	-.1096[illegible]E+02
.79520000E+01	21.5706	375.2362	-.2052	.976655	78.62138	84.6723	.72662216E+01	-.10450208E+02
.79530000E+01	20.5369	377.9486	-.2263	.974060	76.04248	76.1000	.76026079E+01	-.99558207E+01
.79540000E+01	19.4752	380.8694	-.2563	.970967	73.26905	67.7918	.84090836E+01	-.93475450E+01
.79550000E+01	18.3695	384.0131	-.2905	.967107	70.27563	59.6026	.90965419E+01	-.86570667E+01
.79560000E+01	17.2632	387.4272	-.3330	.962367	67.03103	52.1734	.96766064E+01	-.7565[illegible]22E+01
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.79670000E+01	3.9247	459.0558	-3.9110	.637457	359.73216	4.5166	.29602115E+02	.11645687E+02
.79680000E+01	3.0206	470.0072	-5.2215	.548185	349.81622	3.4266	.31111617E+02	.13[illegible]E+02
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.79700000E+01	1.7340	492.7579	-9.1386	.349196	330.39015	2.0731	.31473677E+02	.13717249E+02
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.79720000E+01	1.0653	514.6214	-15.5164	.167563	316.50724	1.4026	.29493049E+02	.11[illegible]E+02
.79730000E+01	.9259	524.7436	-20.2411	.097262	316.72216	1.2156	.27201965E+02	.952[illegible]E+01
.79740000E+01	.8319	534.2707	-26.3289	.048256	335.59794	1.1014	.25608710E+02	.7912[illegible]E+01
.79750000E+01	.7772	543.2459	-28.1242	.039245	26.03487	1.0817	.24229556E+02	.64731256E+01
.79760000E+01	.7436	551.7425	-24.8677	.056427	51.51782	1.1241	.2301224[illegible]E+02	.5255[illegible]E+01
.79770000E+01	.7199	559.8411	-22.4365	.075540	54.81711	1.1634	.22015204E+02	.42567750E+01
.79780000E+01	.6990	567.6160	-21.3771	.085589	52.54057	1.1666	.21213242E+02	.349[illegible]E+01
.79790000E+01	.6782	575.1337	-21.1045	.088059	46.32357	1.1931	.20570406E+02	.2[illegible]E+01
.79800000E+01	.6566	582.4424	-21.4377	.084745	43.32707	1.1852	.20651816E+02	.229[illegible]E+01
.79810000E+01	.6347	589.5816	-22.3215	.076546	36.04213	1.1658	.[illegible]22553E+02	.1466[illegible]E+01
.79820000E+01	.6136	596.5704	-23.7977	.064562	32.77090	1.1381	.19257008E+02	.1901[illegible]E+01
.79830000E+01	.5943	603.4521	-26.0398	.049650	27.64610	1.1050	.18954195E+02	.1777[illegible]E+01
.79840000E+01	.5779	610.2142	-29.5136	.033448	24.03702	1.0692	.18456710E+02	.6092[illegible]E+00
.79850000E+01	.5649	616.8726	-35.7957	.016226	25.10995	1.0330	.18356120E+02	.5999[illegible]E+00
.79860000E+01	.5554	623.4319	-47.4280	.004252	121.49577	1.0085	.18008271E+02	.5256427[illegible]E+00
.79870000E+01	.5494	629.8957	-34.2466	.019390	166.22506	1.0395	.17625255E+02	.6[illegible]E-01
.79880000E+01	.5463	636.2673	-29.0397	.035319	167.56644	1.0732	.17576058E+02	-.1[illegible]E+00
.79890000E+01	.5455	642.5506	-26.0455	.049657	163.51502	1.1045	.17355557E+02	-.420[illegible]E+00
.79900000E+01	.5460	648.7507	-24.0741	.062559	158.67270	1.1335	.1711[illegible]E+02	-.[illegible]E+00
.79910000E+01	.5472	654.8735	-22.7171	.073130	153.52416	1.1578	.16906942E+02	-.6494[illegible]E+00
.79920000E+01	.5482	660.9263	-21.7677	.081590	148.25519	1.1772	.16723649E+02	-.10527[illegible]E+01
.79930000E+01	.5484	666.9173	-21.1874	.087223	142.94991	1.1911	.16564152E+02	-.1195[illegible]E+01
.79940000E+01	.5473	672.8547	-20.8606	.090567	137.65242	1.1992	.16426050E+02	-.1329[illegible]E+01
.79950000E+01	.5448	678.7475	-20.7777	.091435	132.39270	1.2013	.16314660E+02	-.1441[illegible]E+01
.79960000E+01	.5408	684.6090	-20.9252	.089656	127.19461	1.1976	.16225780E+02	-.1550[illegible]E+01
.79970000E+01	.5355	690.4324	-21.3045	.086055	122.06615	1.1883	.16157053E+02	-.15993735E+01
.79980000E+01	.5291	696.2394	-21.9305	.080071	117.10965	1.1741	.16100798E+02	-.16495554E+01
.79990000E+01	.5221	702.0311	-22.8371	.072135	112.33462	1.1555	.16071828E+02	-.1696[illegible]E+01
.80000000E+01	.5151	707.8125	-24.0851	.062940	107.88441	1.1343	.16048321E+02	-.17061172E+01
.80010000E+01	.5085	713.5870	-25.7837	.051864	104.01906	1.1093	.16033576E+02	-.17420327E+01
.80020000E+01	.5020	719.3572	-28.1423	.039164	101.32981	1.0815	.16024006E+02	-.17324255E+01

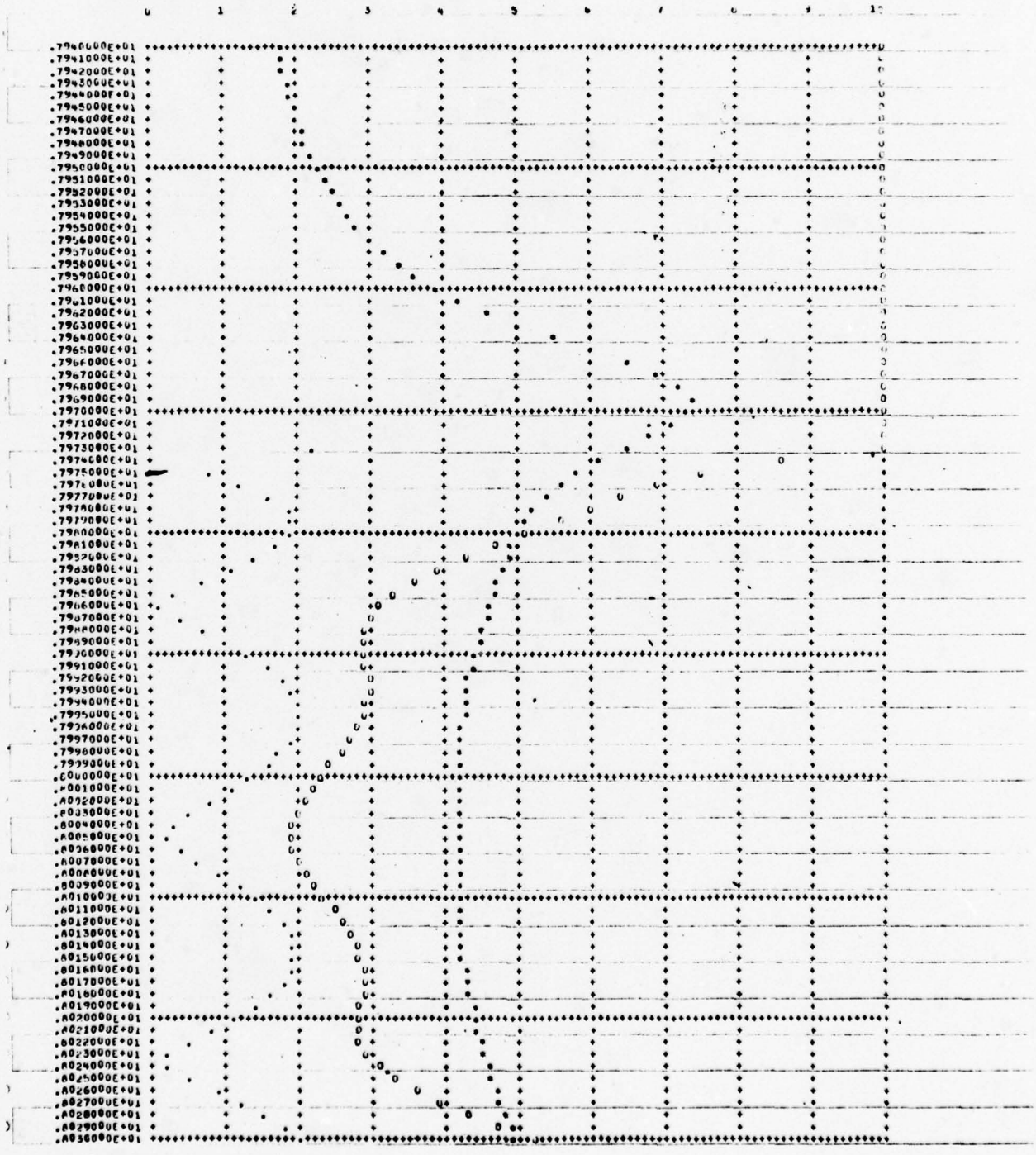
.80030000E+01	.4985	725.1295	-31.6131	.026060	101.67254	1.0559	.16016424E+02	-.17900049E+01
.80040000E+01	.4960	730.8698	-37.2918	.018069	118.79160	1.0277	.16010249E+02	-.17461021E+01
.80050000E+01	.4958	736.6510	-41.9045	.000882	183.62801	1.0168	.16003513E+02	-.17541154E+01
.80060000E+01	.4966	742.4116	-34.6015	.010610	223.18662	1.0379	.15997[illegible]E+02	-.1760[illegible]E+01
.80070000E+01	.4996	748.1606	-30.0505	.031400	226.16170	1.0649	.15980225E+02	-.1760[illegible]634E+01
.80080000E+01	.5042	753.9253	-27.1981	.043930	226.07145	1.0919	.15982434E+02	-.17759945E+01
.80090000E+01	.5100	759.6765	-25.1149	.055455	223.00229	1.1175	.15960620E+02	-.1775[illegible]005E+01
.80100000E+01	.5164	765.4302	-23.6449	.065744	219.47540	1.1407	.15965720E+02	-.17767089E+01
.80110000E+01	.5230	771.1874	-22.5693	.074049	[illegible]	1.1607	.16009727E+02	-.1757[illegible]E+01
.80120000E+01	.5293	776.9583	-21.8087	[illegible]	[illegible]	1.1768	.16028513E+02	-.17279155E+01
.80130000E+01	.5347	782.7300	-21.4136	[illegible]	[illegible]	1.1861	.15675510E+02	-.16629105E+01
.80140000E+01	.5390	788.5274	-21.0969	[illegible]	199.95762	1.1942	.16136675E+02	-.16195559E+01
.80150000E+01	.5419	794.8512	-21.0567	.060749	194.70005	1.19[illegible]	.16221554E+02	-.1[illegible]741E+01
.80160000E+01	.5433	800.2097	-21.2524	.066572	169.55805	1.1698	.16329504E+02	-.142[illegible]49E+01
.80170000E+01	.5435	806.1110	-21.7270	.061962	174.32076	1.1766	.16459457E+02	-.1[illegible]19E+01
.80180000E+01	.5427	812.0602	-22.5052	.074544	179.10217	1.1620	.16611947E+02	-.114[illegible]E+01
.80190000E+01	.5415	818.0792	-23.6612	.065606	173.56514	1.1404	.16705505E+02	-.97[illegible]43E+00
.80200000E+01	.5405	824.1510	-25.3359	.054161	169.04485	1.1144	.16977162E+02	-.77[illegible]57E+00
.80210000E+01	.5406	830.3000	-27.0153	.040666	164.67365	1.0148	.17165261E+02	-.57114771E+00
.80220000E+01	.5423	836.5259	-31.0194	.025667	162.03996	1.0526	.17405506E+02	-.5511[illegible]E+00
.80230000E+01	.5467	842.8330	-40.2216	.009748	170.47590	1.0197	.17654919E+02	-.[illegible]E+00
.80240000E+01	.5540	849.2241	-40.9408	.000973	297.21262	1.0181	.17872610E+02	.1161[illegible]E+00
.80250000E+01	.5640	855.7022	-31.7752	.025766	307.69022	1.0529	.18116242E+02	.3[illegible]E+00
.80260000E+01	.5790	862.2705	-27.4265	.042520	305.31546	1.0068	.18574754E+02	.61830570E+00
.80270000E+01	.5962	868.9341	-24.7115	.056134	300.61301	1.1254	.18648961E+02	.[illegible]74E+00
.80280000E+01	.6150	875.7011	-22.0891	.071704	295.52070	1.1545	.18551411E+02	.119[illegible]E+01
.80290000E+01	.6367	882.5844	-21.6903	.082316	290.25254	1.1794	.15298573E+02	.1541[illegible]E+01
.80300000E+01	.6577	889.6080	-21.0142	.086980	265.06216	1.1953	.19711446E+02	.195[illegible]92E+01
.80310000E+01	.6781	896.7876	-20.8560	.090646	260.23214	1.1594	.20215727E+02	.24552965E+01
.80320000E+01	.6975	904.1790	-21.2855	.086249	276.28404	1.1656	.20842901E+02	.308[illegible]320E+01
.80330000E+01	.7171	911.8133	-22.5145	.074064	274.50275	1.1619	.21625660E+02	.[illegible]E+01
.80340000E+01	.7403	919.7669	-24.9453	.056590	275.03171	1.1200	.22593557E+02	.4[illegible]E+01
.80350000E+01	.7737	928.1056	-26.3782	.038114	306.20945	1.0792	.23706746E+02	.[illegible]170E+01
.80360000E+01	.8291	936.9034	-25.7937	.051323	357.49904	1.1062	.25139617E+02	.73023600E+01
.80370000E+01	.9241	946.2247	-19.6533	.101708	18.62988	1.2264	.26662595E+02	.6905956[illegible]E+01
.80380000E+01	1.0835	956.1039	-15.3052	.171608	13.32030	1.4143	.28214335E+02	.10457907E+02
.80390000E+01	1.3374	966.5177	-11.8490	.255593	7.67415	1.6867	.29592925E+02	.11[illegible]97E+02
.80400000E+01	1.7163	977.3568	-9.1334	.349406	355.67195	2.0741	.30530921E+02	.1[illegible]774492E+02
.80410000E+01	2.2528	988.4150	-6.9456	.447416	350.49765	2.6194	.30772110E+02	.12015690E+02
.80420000E+01	2.9542	999.4115	-5.3027	.543078	346.89762	3.3771	.30174959E+02	.1241[illegible]E+02
.80430000E+01	3.8171	1010.0459	-4.0067	.630474	331.22706	4.4123	.20762630E+02	.11028202E+02
.80440000E+01	4.8190	1020.0650	-3.0272	.705731	322.00115	5.7965	.26800072E+02	.90426430E+01
.80450000E+01	5.9274	1029.3050	-2.2964	.767560	313.40047	7.6622	.24503160E+02	.[illegible]7313E+01
.80460000E+01	7.1074	1037.6996	-1.7613	.816460	305.53381	9.0968	.22159167E+02	.[illegible]82E+01
.80470000E+01	8.3280	1045.2579	-1.3667	.854407	298.41984	12.7370	.19679350E+02	.2122[illegible]14E+01
.80480000E+01	9.5647	1052.0365	-1.0761	.883472	292.02066	16.1633	.17618274E+02	.6165[illegible]44E-01
.80490000E+01	10.8000	1058.1148	-.8606	.905655	286.27172	20.1962	.15989260E+02	-.17671606E+01
.80500000E+01	12.0217	1063.5765	-.6956	.922610	281.09826	24.8432	.14391765E+02	-.3364[illegible]32E+01
.80510000E+01	13.2221	1068.5024	-.5777	.935655	276.42761	30.0617	.13007400E+02	-.474[illegible]11E+01
.80520000E+01	14.3967	1072.9644	-.4842	.945776	272.19515	35.0536	.11610947E+02	-.59[illegible]E+01
.80530000E+01	15.5429	1077.0254	-.4117	.953708	268.33672	42.2043	.10774820E+02	-.69810086E+01
.80540000E+01	16.6599	1080.7387	-.3546	.959995	264.80659	48.9936	.96755964E+01	-.7[illegible]32E+01
.80550000E+01	17.7474	1084.1497	-.3092	.965035	261.56614	56.1973	.90918775E+01	-.86647511E+01
.80560000E+01	18.8058	1087.2964	-.2724	.969120	258.57358	63.7672	.84050625E+01	-.9531[illegible]E+01
.80570000E+01	19.8361	1090.2111	-.2425	.972471	255.80039	71.6519	.78602454E+01	-.9[illegible]52E+01
.80580000E+01	20.8392	1092.9209	-.2177	.975249	253.22137	79.0038	.72646626E+01	-.10491[illegible]E+02
.80590000E+01	21.8162	1095.4489	-.1970	.977577	250.81443	86.1922	.67806241E+01	-.1[illegible]E+02
.80600000E+01	22.7682	1097.8148	-.1795	.979547	248.56106	96.7851	.63829984E+01	-.11593430E+02
.80610000E+01	23.6964	1100.0354	-.1646	.981230	246.44545	99.0000	.59799988E+01	-.11776430E+02
.80620000E+01	24.6018	1102.1250	-.1518	.982678	244.45919	99.0000	.56399401E+01	-.12121403E+02
.80630000E+01	25.4856	1104.0964	-.1406	.983939	242.57464	99.0000	.53222662E+01	-.12434162E+02
.80640000E+01	26.3487	1105.9604	-.1309	.985046	240.79715	99.0000	.50376050E+01	-.1271[illegible]24E+02
.80650000E+01	27.1922	1107.7265	-.1223	.986016	239.11259	99.0000	.47779715E+01	-.1297[illegible]57E+02
.80660000E+01	28.0168	1109.4081	-.1147	.986888	237.51290	99.0000	.45399794E+01	-.1321[illegible]49E+02
.80670000E+01	28.8235	1110.9976	-.1079	.987651	235.99129	99.0000	.43212294E+01	-.1343[illegible]99E+02
.80680000E+01	29.6131	1112.5165	-.1018	.988344	234.54140	99.0000	.41197170E+01	-.13650712E+02
.80690000E+01	30.3862	1113.9656	-.0963	.988970	233.15786	99.0000	.39381490E+01	-.13823280E+02

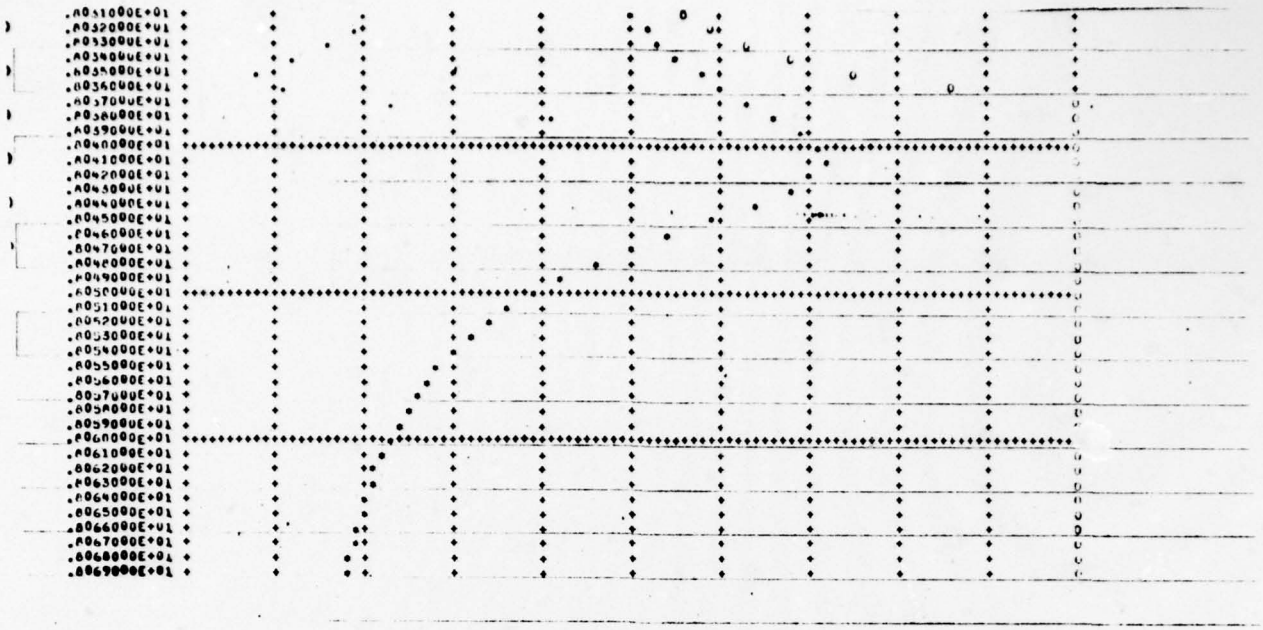
LOCK YOUNG FILTER
FILTER DESIGN PLOTS

STANDING WAVE RATIO AND TIME DELAY VS FREQUENCY
SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 2 (TIME DELAY VS FREQUENCY) = 0
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = 0

Y AXIS SCALE

PLOT	LOWER	CENTER	UPPER
1	.1000E+01	.1540E+01	.2100E+01
2	-.5000E+01	.2060E+02	.4500E+02
3	.4000E+00	.6500E+00	.9000E+00





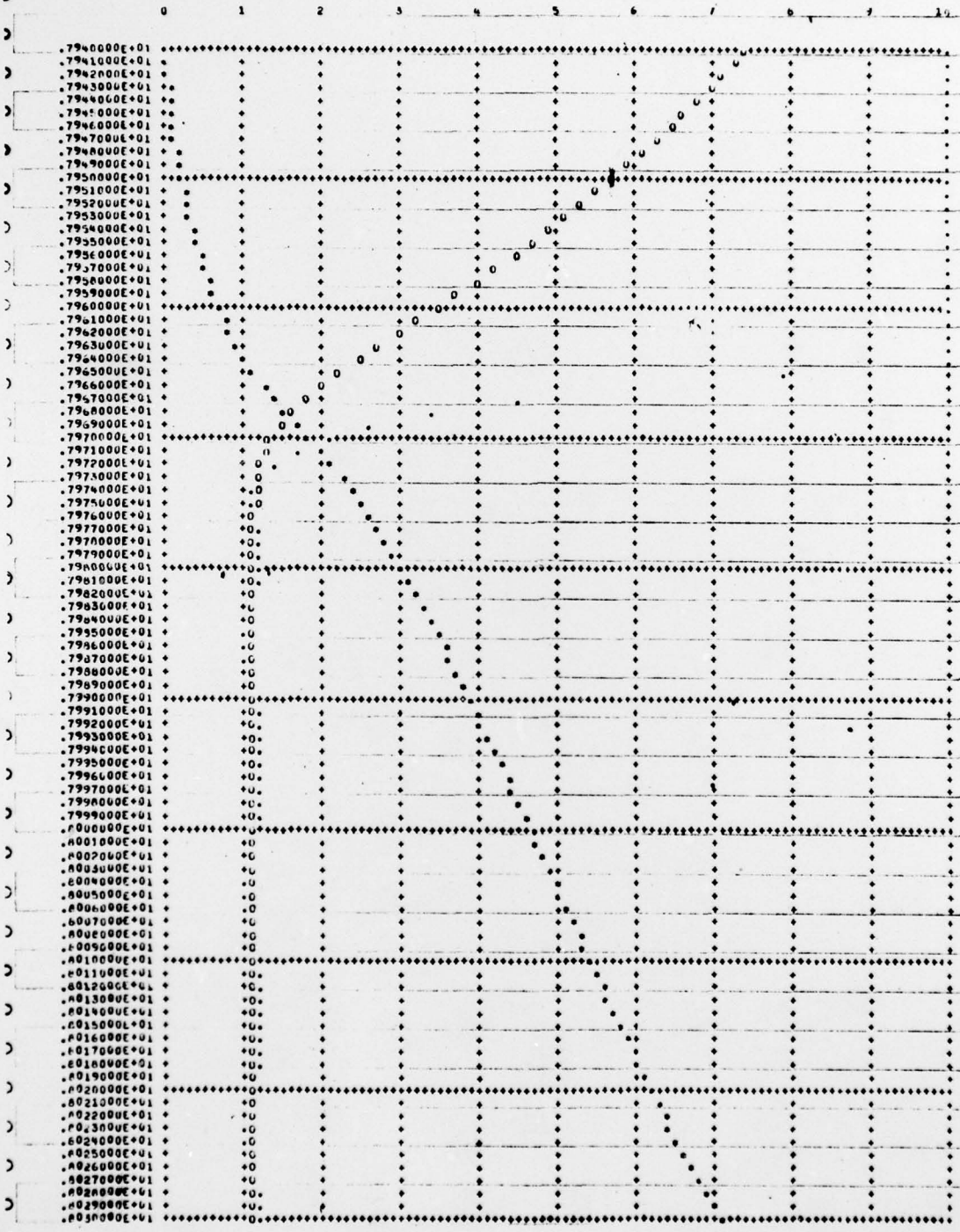
LOCK YOUNG FILTER
FILTER DESIGN PLOTS

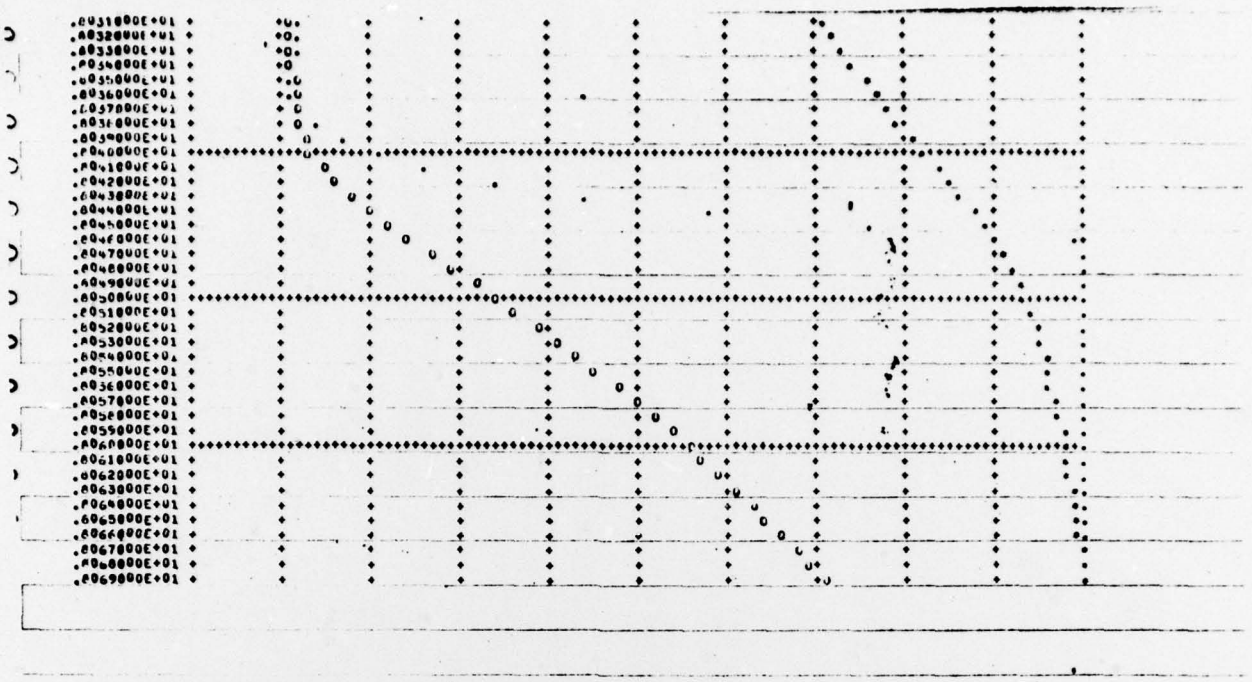
INSERTION LOSS AND INSERTION PHASE VS FREQUENCY

SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 2 (INSERTION PHASE VS FREQUENCY) = +
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = 0

Y AXIS SCALE

PLOT	LOWER	CENTER	UPPER
1	.0000E+01	.500E+01	.100E+02
2	.3520E+03	.7830E+03	.1114E+04
3	-.5000E+01	.2000E+02	.4500E+02





FILTER DESIGN

LOCK YOUNG FILTER

.0400 DB LOSS POINT 5 CAVITIES .00000 DB RIPPLE TCHEBYSCHEFF FILTER

ORIGINAL F1 = 7972.00000 F2 = 8030.00000 BANDWIDTH = 66.00000 FO = 8004.71112
CORRECTED F1 = 7972.00000 F2 = 8030.00000 BANDWIDTH = 66.00000 FC = 8001.53165

A = 1.37200 B = .62200000 I = .05000 E = 1.00000
QU = 16000.00000 N = 1.00000000 CL = .62200 CLS = .00500
OMEGA-PR = 1.00000 DTOL = .00500000 LU = 0.00000 RHO = 90.00000

DESIGN CHARACTERISTICS LAMDA-GO/4 = .437082 INCHES = 1.110189 CM.

G	B	CAVITY LENGTH (CL)
.0102	7.1141	.83161
.9576	62.8976	.66651
1.3704	65.9453	.66749
1.7875	65.9453	.66651
1.3704	62.8976	.83161
.9576	7.1141	0.00000
.0102	0.0000	0.00000

PRACTICAL DESIGN DIMENSIONS SUSCEPTANCE FOR THE STAMLINIC VANE.

CAVITY LENGTH (CL)	GAP WIDTH (D)	SUSCEPTANCE (B)	B1	DELTA L
.86237	.3916596	7.15748	27.64900	.0100(
.98367	.1873327	61.86261	66.52617	.00918
.90539	.1688958	65.76185	76.18026	.00365

FILTER DESIGN - ANALYSIS OUTPUT

LOCK YOUNG FILTER

FREQUENCY	INSERTION LOSS	INSERTION PHASE	GAMMA(DB)	ABS VALUE OF GAMMA	ANGLE OF GAMMA	STANDING WAVE RATIO	GROUP DELAY(NS)	DISPERSIO
.79800000E+01	30.6526	355.6130	-.0907	.989607	97.14900	99.0000	.69416881E+01	-.13473279E+02
.7981000CE+01	29.8619	357.0795	-.0960	.989085	95.74563	99.0000	.91865976E+01	-.1520[7[4E+02
.79820000E+01	29.0549	358.6163	-.1019	.988480	94.27521	99.0000	.96725105E+01	-.1[30[[[[E+02
.79830000E+01	28.2308	360.2296	-.1084	.987796	92.73196	99.0000	.9599[[[[E+01	-.1[[[[[[[E+02
.79840000E+01	27.3888	361.9260	-.1157	.987049	91.10951	99.0000	.96280795E+01	-.1[[[[[[[E+02
.79850000E+01	26.5280	363.7129	-.1240	.986235	89.40185	99.0000	.9[[[[[[[E+01	-.1[[[[[[[E+02
.79860000E+01	25.6475	365.5988	-.1334	.985340	87.59459	99.0000	.95[[[[[[E+01	-.1[[[[[[[E+02
.79870000E+01	24.7464	367.5932	-.1442	.984353	85.69474	99.0000	.97[[[[[[E+01	-.1[[[[[[[E+02
.79880000E+01	23.8236	369.7073	-.1566	.983252	83.67326	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79890000E+01	22.8781	371.9540	-.1711	.981993	81.52759	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79900000E+01	21.9087	374.3479	-.1881	.978573	79.24217	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79910000E+01	20.9144	376.9059	-.2084	.976297	76.80000	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79920000E+01	19.8939	379.6486	-.2327	.973570	74.18912	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79930000E+01	18.8462	382.5988	-.2621	.970278	71.37037	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79940000E+01	17.7703	385.7848	-.2983	.966230	68.33300	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79950000E+01	16.6655	389.2393	-.3433	.961243	65.04115	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79960000E+01	15.5312	393.0014	-.4000	.954967	61.45776	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79970000E+01	14.3676	397.1172	-.4724	.946062	57.53953	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79980000E+01	13.1760	401.6418	-.5660	.934610	53.23672	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79990000E+01	11.9590	406.6895	-.6867	.920760	48.49173	99.0000	.[[[[[[[[E+01	-.1[[[[[[[E+02
.79600000E+01	10.7219	412.1835	-.8515	.906618	43.21681	20.9173	.1668[[[[E+02	-.1[[[[[[[E+01
.79610000E+01	9.4713	418.3567	-1.0699	.884114	37.36668	16.6588	.1869[[[[E+02	-.1[[[[[[[E+00
.79620000E+01	8.2219	425.3440	-1.3657	.854501	30.68931	12.7495	.2020[[[[E+02	-.1[[[[[[[E+01
.79630000E+01	6.9969	432.9246	-1.7668	.815763	23.59814	9.6050	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79640000E+01	5.8038	441.4523	-2.3169	.765695	15.57177	7.0359	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79650000E+01	4.6535	450.8804	-3.0065	.702545	6.82199	5.1437	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79660000E+01	3.6952	460.9645	-4.0718	.625762	357.99356	3.7492	.2[[[[[[[E+02	-.1[[[[[[[E+02
.79670000E+01	2.6413	471.7259	-5.4019	.536945	347.66659	2.8191	.2[[[[[[[E+02	-.1[[[[[[[E+02
.79680000E+01	2.1529	482.7998	-7.1254	.440280	337.92919	2.0752	.2[[[[[[[E+02	-.1[[[[[[[E+02
.79690000E+01	1.6331	493.6955	-9.3215	.341922	328.68692	1.8392	.2[[[[[[[E+02	-.1[[[[[[[E+02
.79700000E+01	1.2664	504.7341	-12.0953	.248947	320.69267	1.6615	.2959[[[[E+02	-.1[[[[[[[E+02
.79710000E+01	1.0243	515.1180	-15.6324	.165841	315.00367	1.3962	.2[[[[[[[E+02	-.1[[[[[[[E+02
.79720000E+01	.8740	524.9489	-20.3000	.096665	314.06320	1.2139	.2851[[[[E+02	-.1[[[[[[[E+02
.79730000E+01	.7851	534.2126	-26.4455	.047618	332.30170	1.1018	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79740000E+01	.7337	542.9496	-28.6916	.036769	26.07925	1.0763	.2359[[[[E+02	-.1[[[[[[[E+01
.79750000E+01	.7027	551.2280	-25.0591	.055058	51.69690	1.1183	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79760000E+01	.6809	559.1228	-22.6648	.073560	55.96639	1.1508	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79770000E+01	.6622	566.7094	-21.4350	.084269	58.49452	1.1691	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79780000E+01	.6435	574.0304	-21.1010	.088058	59.32101	1.1748	.2[[[[[[[E+02	-.1[[[[[[[E+01
.79790000E+01	.6238	581.1587	-21.3181	.085970	58.99659	1.1681	.1958[[[[E+02	-.1[[[[[[[E+01
.79800000E+01	.6035	588.1176	-22.0892	.078965	58.24280	1.1715	.1912[[[[E+02	-.1[[[[[[[E+01
.79810000E+01	.5835	594.9376	-23.3264	.068189	56.80525	1.1967	.1877[[[[E+02	-.1[[[[[[[E+01
.79820000E+01	.5649	601.6474	-25.2643	.054549	54.98443	1.1158	.1865[[[[E+02	-.1[[[[[[[E+01
.79830000E+01	.5486	608.2297	-28.1833	.038979	52.46583	1.0811	.1817[[[[E+02	-.1[[[[[[[E+00
.79840000E+01	.5354	614.7224	-33.0157	.022447	48.78798	1.0457	.1790[[[[E+02	-.1[[[[[[[E+00
.79850000E+01	.5254	621.1206	-44.5376	.006669	44.09679	1.0192	.1774[[[[E+02	-.1[[[[[[[E+00
.79860000E+01	.5187	627.4274	-58.0024	.001258	165.25806	1.0054	.1739[[[[E+02	-.1[[[[[[[E-01
.79870000E+01	.5150	633.6463	-30.9171	.028459	196.03750	1.0586	.1713[[[[E+02	-.1[[[[[[[E+00
.79880000E+01	.5137	639.7799	-27.2695	.043509	165.66799	1.0969	.1693[[[[E+02	-.1[[[[[[[E+00
.79890000E+01	.5141	645.8328	-26.9459	.044860	161.16499	1.1208	.1678[[[[E+02	-.1[[[[[[[E+00
.79900000E+01	.5154	651.8090	-28.8515	.036787	156.22535	1.1339	.1667[[[[E+02	-.1[[[[[[[E+00
.79910000E+01	.5160	657.7170	-29.2380	.034866	151.11159	1.1375	.1658[[[[E+02	-.1[[[[[[[E+01
.79920000E+01	.5170	663.5614	-31.4792	.026864	145.93627	1.1369	.1653[[[[E+02	-.1[[[[[[[E+01
.79930000E+01	.5178	669.3505	-31.8053	.025971	140.75190	1.1358	.1651[[[[E+02	-.1[[[[[[[E+01

.79940000E+01	.5165	675.0924	-20.7757	.091496	135.80677	1.2013	.15691317E+02	-.15650460E+01
.79950000E+01	.5137	680.7949	-20.7695	.091822	136.06590	1.2015	.15792695E+02	-.16684695E+01
.79960000E+01	.5096	686.4657	-20.9769	.089808	12[illegible]	1.1962	.15714822E+02	-.17013909E+01
.79970000E+01	.5042	692.1110	-21.4087	.085629	120.99011	1.1659	.15655657E+02	-.18013179E+01
.79980000E+01	.4979	697.7493	-22.0768	.078733	115.60690	1.1709	.15611540E+02	-.18446252E+01
.79990000E+01	.4912	703.3557	-23.0169	.070644	110.96235	1.1520	.15561257E+02	-.18751179E+01
.80000000E+01	.4844	708.9590	-24.2977	.060970	106.64064	1.1299	.15561046E+02	-.18953169E+01
.80010000E+01	.4781	714.5565	-26.0245	.049970	102.80705	1.1052	.15548060E+02	-.19062972E+01
.80020000E+01	.4720	720.1501	-28.4128	.037945	100.30077	1.0769	.15539108E+02	-.19172621E+01
.80030000E+01	.4666	725.7469	-31.9254	.025586	100.71067	1.0520	.15532305E+02	-.19240555E+01
.80040000E+01	.4664	731.3374	-37.7152	.013012	112.98560	1.0264	.15526144E+02	-.19302207E+01
.80050000E+01	.4658	736.9257	-41.9646	.007987	185.32766	1.0160	.15519985E+02	-.19367995E+01
.80060000E+01	.4670	742.5114	-34.4067	.016168	223.99520	1.0370	.15512266E+02	-.19440900E+01
.80070000E+01	.4699	748.0995	-30.2418	.030780	228.68775	1.0634	.15504798E+02	-.19515714E+01
.80080000E+01	.4742	753.6751	-27.3372	.042967	227.39795	1.0698	.15498691E+02	-.19571745E+01
.80090000E+01	.4797	759.2540	-25.2983	.054335	224.20302	1.1145	.15496195E+02	-.19561701E+01
.80100000E+01	.4859	764.8380	-23.6092	.064497	220.14083	1.1370	.15498696E+02	-.19560660E+01
.80110000E+01	.4922	770.4147	-22.7119	.073186	215.72564	1.1579	.15511245E+02	-.19451199E+01
.80120000E+01	.4983	776.0026	-21.9203	.080169	211.02056	1.1743	.15534460E+02	-.19213766E+01
.80130000E+01	.5037	781.6014	-21.3658	.085255	206.15765	1.1864	.15572955E+02	-.18854121E+01
.80140000E+01	.5080	787.2170	-21.0614	.088294	201.18917	1.1937	.15647520E+02	-.18283453E+01
.80150000E+01	.5111	792.8555	-20.9363	.089168	196.14852	1.1958	.15761093E+02	-.17532721E+01
.80160000E+01	.5126	798.5243	-21.1521	.087760	191.06102	1.1925	.15795580E+02	-.16663013E+01
.80170000E+01	.5131	804.2307	-21.5035	.084106	185.94561	1.1857	.15910205E+02	-.15461593E+01
.80180000E+01	.5124	809.9821	-22.1419	.078146	180.83535	1.1695	.16048115E+02	-.14102995E+01
.80190000E+01	.5110	815.7662	-23.1031	.069959	175.76442	1.1564	.16201301E+02	-.12550050E+01
.80200000E+01	.5096	821.6493	-24.4666	.059650	170.62090	1.1269	.16374917E+02	-.10814460E+01
.80210000E+01	.5067	827.5779	-26.4797	.047426	166.10590	1.0996	.16565311E+02	-.89290412E+00
.80220000E+01	.5091	833.5765	-29.4985	.033572	162.39108	1.0694	.16764940E+02	-.68142523E+00
.80230000E+01	.5116	839.6498	-34.7316	.018841	161.82089	1.0574	.16976323E+02	-.46004220E+00
.80240000E+01	.5166	845.8004	-46.1466	.005914	209.66690	1.0079	.17195300E+02	-.26097659E+00
.80250000E+01	.5246	852.0312	-36.1621	.015556	306.15009	1.0316	.17421230E+02	-.35131320E-01
.80260000E+01	.5359	858.3447	-29.8671	.032110	307.22462	1.0666	.17655109E+02	.19674447E+00
.80270000E+01	.5502	864.7493	-26.3543	.048115	303.58948	1.1011	.17900761E+02	.44430602E+00
.80280000E+01	.5672	871.2354	-24.0468	.062742	298.85609	1.1339	.18164516E+02	.7063[illegible]E+00
.80290000E+01	.5859	877.8264	-22.4778	.075171	293.74515	1.1626	.18453849E+02	.10021316E+01
.80300000E+01	.6055	884.5310	-21.4556	.084569	288.54365	1.1846	.18793399E+02	.13420457E+01
.80310000E+01	.6249	891.3690	-20.9171	.089960	283.65717	1.1970	.19205196E+02	.17461296E+01
.80320000E+01	.6433	898.3601	-20.8736	.090431	278.75742	1.1968	.19694557E+02	.22619914E+01
.80330000E+01	.6606	905.5660	-21.4164	.084934	274.96965	1.1656	.20311510E+02	.28571450E+01
.80340000E+01	.6781	913.0103	-22.7743	.072650	273.42860	1.1567	.21072495E+02	.35161299E+01
.80350000E+01	.6992	920.7592	-25.3829	.053007	276.57166	1.1137	.22607420E+02	.45510612E+01
.80360000E+01	.7303	928.6708	-28.9495	.035660	306.49347	1.0740	.23153311E+02	.56767446E+01
.80370000E+01	.7826	937.4376	-25.8524	.050976	.33460	1.1074	.24443613E+02	.69072406E+01
.80380000E+01	.8725	946.4951	-19.0922	.101249	14.99956	1.2253	.25891440E+02	.84550748E+01
.80390000E+01	1.0229	956.0853	-15.4129	.169572	14.34666	1.4084	.27369916E+02	.99155451E+01
.80400000E+01	1.2618	966.1826	-11.9997	.251199	8.73879	1.6709	.28657041E+02	.11241676E+02
.80410000E+01	1.6190	976.6975	-9.3106	.342351	.90314	2.0411	.29654672E+02	.12117807E+02
.80420000E+01	2.1201	987.4437	-7.1716	.437945	351.94600	2.5564	.29947236E+02	.12493606E+02
.80430000E+01	2.7789	998.1666	-5.9824	.531961	342.50470	3.2781	.29490667E+02	.12054302E+02
.80440000E+01	3.5930	1008.5869	-4.1696	.618750	333.05084	4.2460	.28281766E+02	.10829425E+02
.80450000E+01	4.5436	1018.4599	-3.1677	.694410	323.93511	5.5447	.26467370E+02	.90510049E+01
.80460000E+01	5.6018	1027.6175	-2.4150	.757271	315.86856	7.2297	.24380657E+02	.66944925E+01
.80470000E+01	6.7351	1035.9801	-1.8553	.807671	307.55056	9.3969	.22106866E+02	.44503006E+01
.80480000E+01	7.9138	1043.5423	-1.4411	.847119	300.39523	12.0621	.19927502E+02	.24708371E+01
.80490000E+01	9.1136	1050.3476	-1.1343	.877572	293.95144	15.3362	.17913354E+02	.45693192E+00
.80500000E+01	10.3163	1056.4651	-.9060	.900951	288.14392	19.1919	.16109905E+02	-.13464550E+01
.80510000E+01	11.5095	1061.9726	-.7346	.918904	282.91740	23.6623	.14522269E+02	-.2933[illegible]E+01
.80520000E+01	12.6646	1066.9459	-.6047	.932758	278.18827	28.7612	.13139555E+02	-.43162250E+01
.80530000E+01	13.8367	1071.4550	-.5050	.943513	273.89738	34.4664	.11938287E+02	-.55127302E+01
.80540000E+01	14.9627	1075.5610	-.4277	.951949	269.98729	40.6223	.10690594E+02	-.65597704E+01
.80550000E+01	16.0612	1079.3167	-.3670	.958630	266.40882	47.3948	.99699981E+01	-.74663568E+01
.80560000E+01	17.1318	1082.7675	-.3166	.963980	263.11938	54.5250	.91981692E+01	-.82561956E+01
.80570000E+01	18.1746	1085.9511	-.2757	.968307	260.08347	62.1057	.85058331E+01	-.89523314E+01
.80580000E+01	19.1903	1088.9001	-.2460	.971849	257.27011	70.0444	.76921507E+01	-.95642262E+01
.80590000E+01	20.1797	1091.6419	-.2219	.974776	254.65356	78.2294	.73504046E+01	-.10101961E+02
.80600000E+01	21.1438	1094.1996	-.2001	.977221	252.21181	86.8602	.66685519E+01	-.10577433E+02
.80610000E+01	22.0837	1096.5933	-.1818	.979285	249.92595	95.5368	.64573050E+01	-.11013059E+02
.80620000E+01	23.0005	1098.8398	-.1663	.981040	247.78002	99.0000	.60500875E+01	-.11405277E+02
.80630000E+01	23.8947	1100.9539	-.1529	.982545	245.75997	99.0000	.57007300E+01	-.11753626E+02
.80640000E+01	24.7680	1102.9482	-.1414	.983851	243.85370	99.0000	.53859516E+01	-.12072413E+02
.80650000E+01	25.6210	1104.8338	-.1314	.984990	242.05106	99.0000	.50963929E+01	-.12353972E+02
.80660000E+01	26.4548	1106.6205	-.1225	.985992	240.34242	99.0000	.48339660E+01	-.12622397E+02
.80670000E+01	27.2701	1108.3166	-.1147	.986876	238.72014	99.0000	.45925504E+01	-.12865606E+02
.80680000E+01	28.0678	1109.9296	-.1078	.987666	237.17607	99.0000	.43719855E+01	-.13069430E+02
.80690000E+01	28.8467	1111.4663	-.1016	.988378	235.70653	99.0000	.41670992E+01	-.13297266E+02

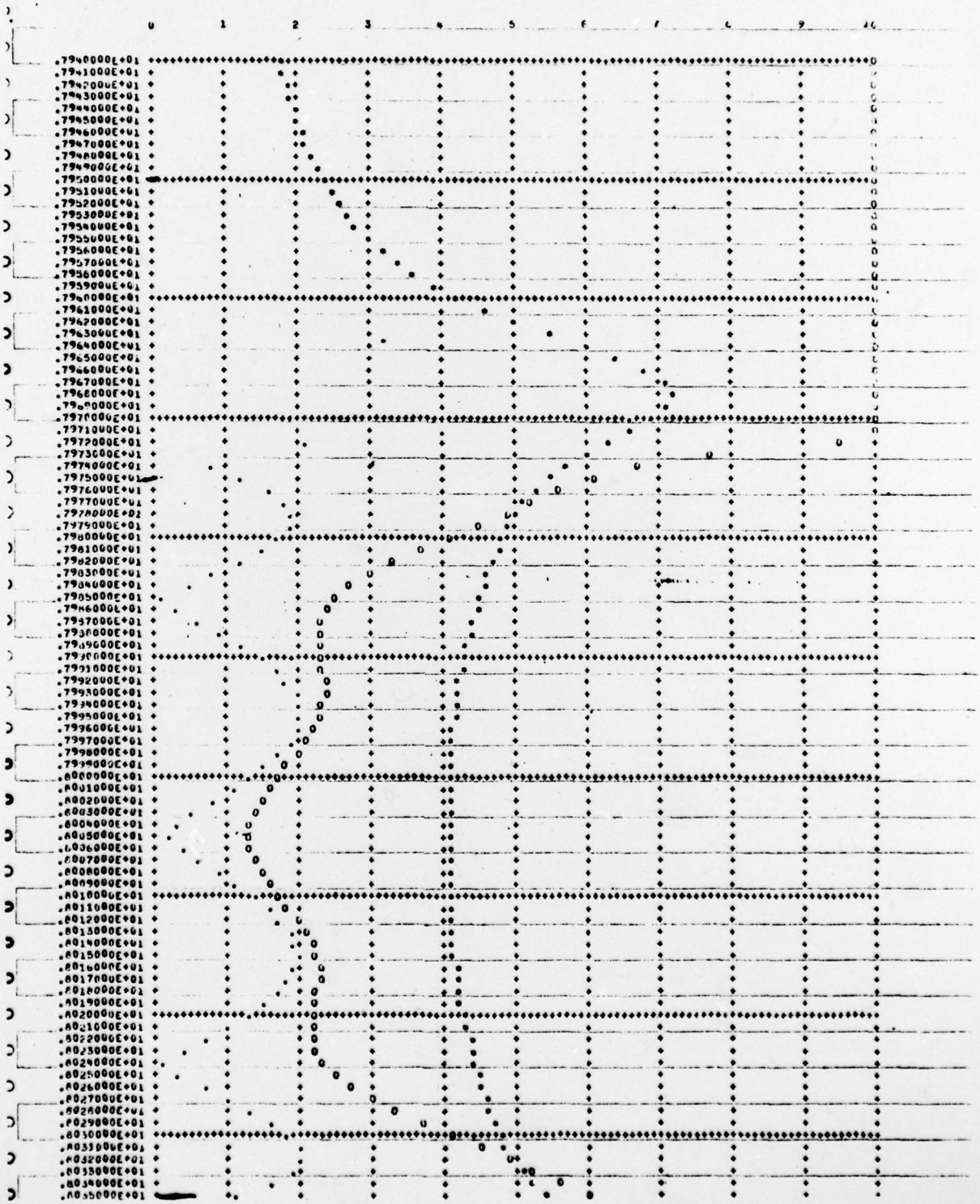
LOCK YOUNG FILTER
FILTER DESIGN PLOTS

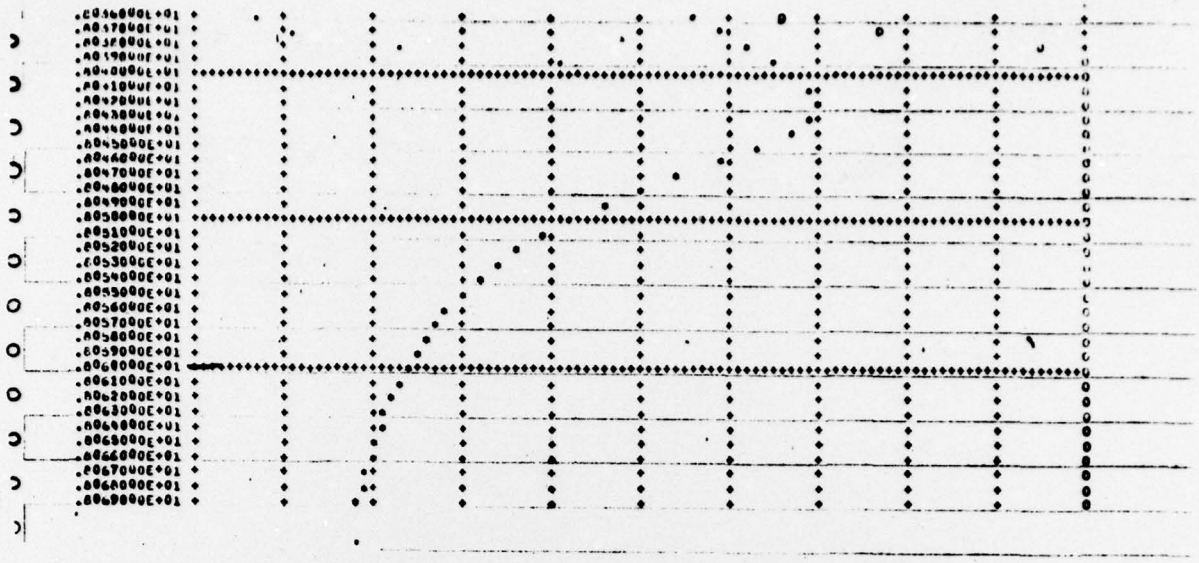
STANDING WAVE RATIO AND TIME DELAY VS FREQUENCY

SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = 0
SYMBOL FOR GRAPH 2 (TIME DELAY VS FREQUENCY) = 0
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = U

Y AXIS SCALE

PLOT	LOWER	CENTER	UPPER
1	.1000E+01	.1500E+01	.2000E+01
2	-.5000E+01	.2000E+02	.4500E+02
3	.4000E+00	.6500E+00	.9000E+00





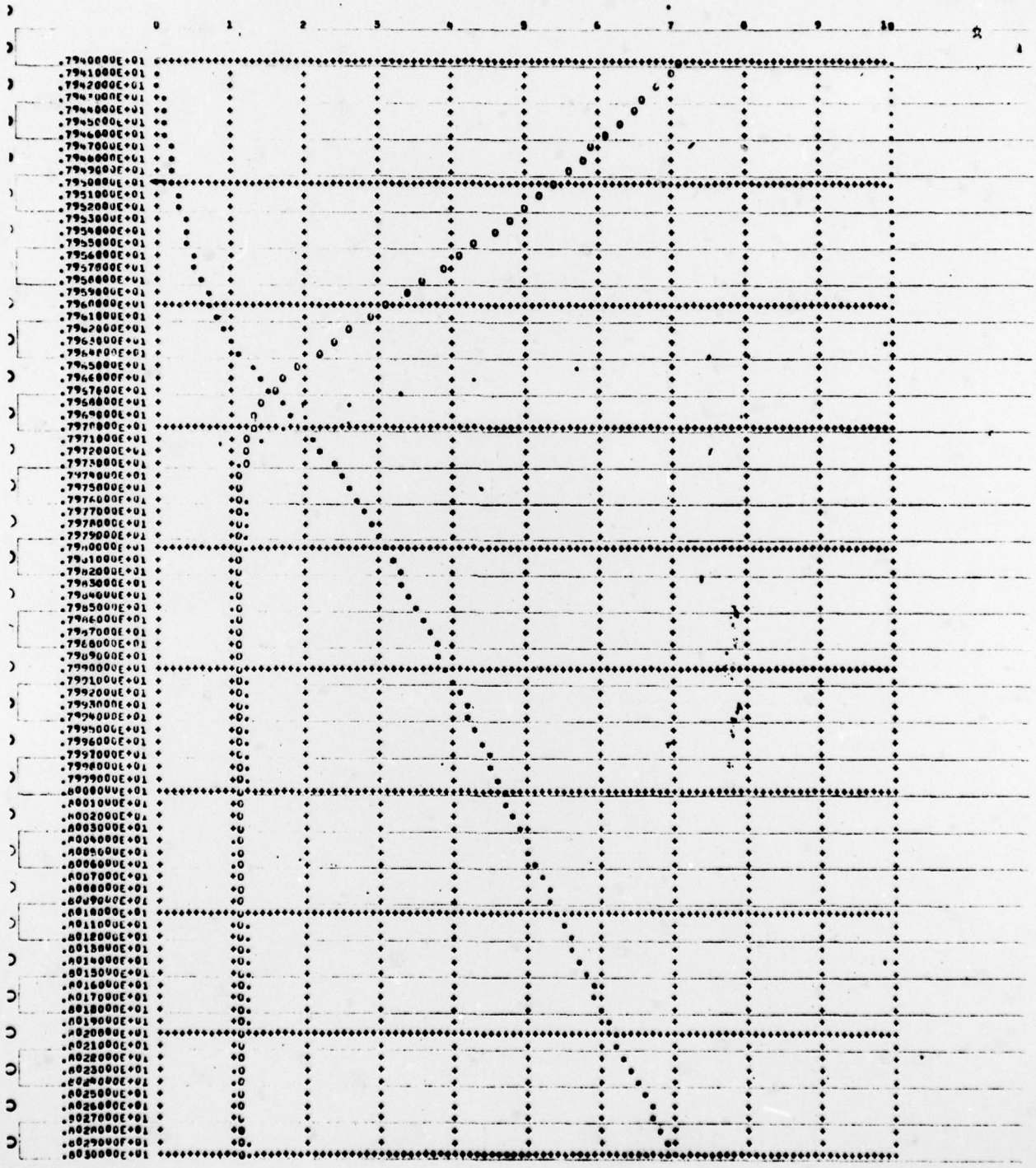
LOCK YOUNG FILTER
FILTER DESIGN PLOTS

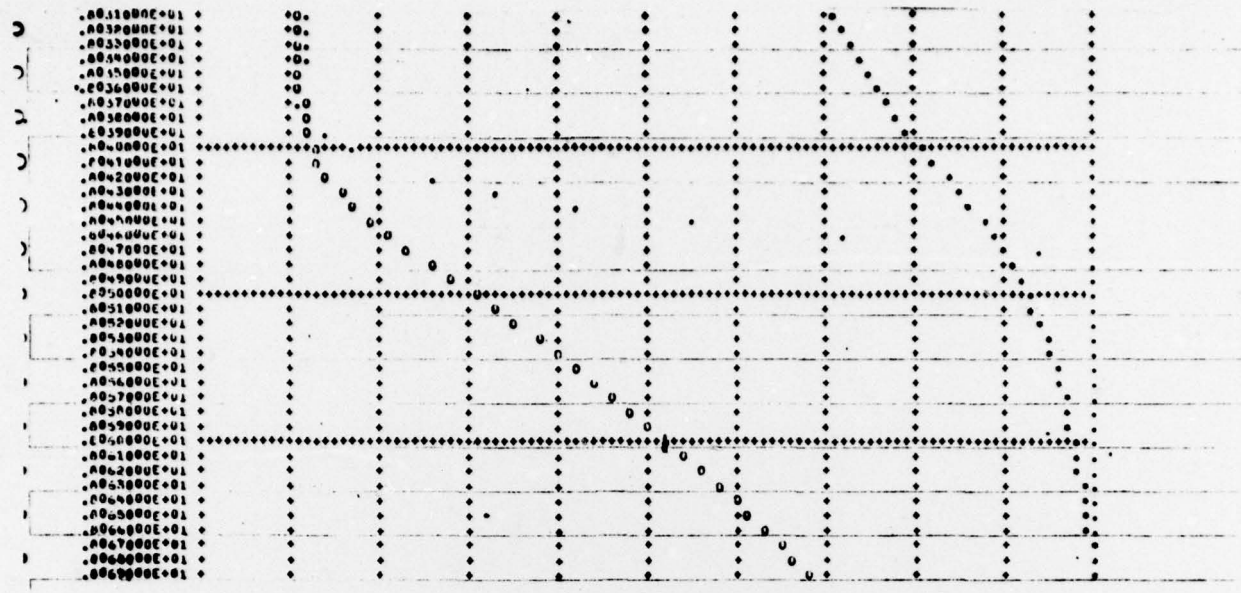
INSERTION LOSS AND INSERTION PHASE VS FREQUENCY

SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 2 (INSERTION PHASE VS FREQUENCY) = @
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = 0

Y AXIS SCALE

PLOT	LOWER	CENTER	UPPER
1	.8888E+01	.8888E+01	.1000E+02
2	.3984E+03	.7500E+03	.1111E+04
3	-.5000E+01	.8000E+02	.9000E+02





FILTER DESIGN

LOCK YOUNG FILTER

.0000 Db LOSS POINT 5 CAVITIES .00000 Db RIPPLE TCHEBYSCHEFF FILTER

ORIGINAL F1 =	7979.00000	F2 = 8036.00000	BANDWIDTH =	48.00000	FO = 8004.80665
CORRECTED F1 =	7979.00000	F2 = 8036.00000	BANDWIDTH =	48.00000	FC = 8001.35164

A =	1.37200	B =	.62800000	I =	.05000	E =	1.00000
QU =	10000.00000	R =	1.00000000	M =	.6200	CLS =	.07500
DMEGA-PH =	1.00000	DTOL =	.00200000	LO =	8.80000	RHO =	8.80000

DESIGN CHARACTERISTICS LAMDA-GO/4 = .487000 INCHES = 1.110104 CM.

G	b	CAVITY LENGTH (CL)
.0171	7.3986	.05309
.9576	60.9570	.06497
1.3709	91.4917	.06000
1.7875	91.4917	.06697
1.3709	60.9570	.05309
.9576	7.3986	0.00000
.0171	0.0000	0.00000

PRACTICAL DESIGN DIMENSIONS SUSCEPTANCE FOR THE SYMMETRIC NAME.

CAVITY LENGTH (CL)	GAP WIDTH (D)	SUSCEPTANCE (B)	B1	DELTA L
.06905	.3073869	7.39032	27.90296	.00994
.08934	.1834605	65.81890	68.69093	.00987
.08897	.1659597	89.20829	78.29084	.00395

FILTER DESIGN - ANALYSIS OUTPUT

LOCK YOUNG FILTER

FREQUENCY	INSERTION LOSS	INSERTION PHASE	GAMMA(DE)	ABS VALUE OF GAMMA	ANGLE OF GAMMA	STANDING WAVE RATIO	GROUP DELAY(NS)	DISPERSION
.79400000E+01	33.7637	350.0705	-.0830	.990655	102.79840	99.0000	.8559089E+01	-.1451245E+02
.79410000E+01	36.0063	351.3799	-.0873	.990009	101.94825	99.0000	.8737366E+01	-.1456486E+02
.79420000E+01	32.2173	352.7406	-.0930	.989969	100.24498	99.0000	.8868269E+01	-.1491325E+02
.79430000E+01	31.4101	354.1411	-.0971	.989842	98.98126	99.0000	.9072357E+01	-.1490529E+02
.79440000E+01	30.5860	355.6825	-.1020	.989824	97.45225	99.0000	.9273780E+01	-.1536566E+02
.79450000E+01	29.7442	357.2588	-.1091	.967513	95.95430	99.0000	.9481189E+01	-.1555066E+02
.79460000E+01	28.8868	358.9162	-.1142	.986711	94.37556	99.0000	.9728224E+01	-.1584168E+02
.79470000E+01	28.0039	360.6621	-.1241	.985819	92.71581	99.0000	.9979895E+01	-.1609438E+02
.79480000E+01	27.1035	362.5046	-.1330	.984799	90.96350	99.0000	.1026496E+02	-.1654756E+02
.79490000E+01	26.1817	364.4542	-.1452	.983649	89.11168	99.0000	.1057016E+02	-.1695064E+02
.79500000E+01	25.2378	366.5169	-.1549	.982326	87.14496	99.0000	.1091135E+02	-.1741719E+02
.79510000E+01	24.2691	368.7137	-.1679	.980862	85.06592	99.0000	.1127493E+02	-.1787939E+02
.79520000E+01	23.2759	371.0520	-.1841	.979030	82.84489	99.0794	.1167965E+02	-.1838956E+02
.79530000E+01	22.2564	373.5506	-.2026	.976963	80.47807	85.7429	.1210875E+02	-.1889302E+02
.79540000E+01	21.2098	376.2291	-.2247	.974659	77.93184	77.0057	.1258078E+02	-.1938176E+02
.79550000E+01	20.1338	379.1103	-.2513	.971970	75.19960	69.1218	.1309178E+02	-.1984903E+01
.79560000E+01	19.0270	382.2215	-.2838	.967841	72.25490	61.2101	.1365907E+02	-.2031072E+01
.79570000E+01	17.8894	385.5951	-.3240	.963385	69.05021	53.6620	.1426834E+02	-.2080159E+01
.79580000E+01	16.7199	389.2698	-.3743	.957817	65.57621	46.4130	.1496678E+02	-.2141458E+01
.79590000E+01	15.5167	393.2920	-.4364	.950784	61.76760	39.6671	.1570399E+02	-.2209619E+01
.79600000E+01	14.2817	397.7176	-.5210	.941782	57.56241	33.5886	.1649639E+02	-.2286216E+01
.79610000E+01	13.0159	402.6111	-.6292	.930119	52.95720	27.0199	.1733644E+02	-.2369128E+01
.79620000E+01	11.7230	408.0519	-.7761	.914840	47.72040	24.4858	.1825167E+02	-.2461572E+01
.79630000E+01	10.4098	414.1291	-.9670	.894649	42.09118	17.9083	.1925382E+02	-.2565110E+01
.79640000E+01	9.0879	420.9086	-1.2315	.867818	36.04149	14.1301	.2036228E+02	-.2679621E+01
.79650000E+01	7.7782	428.5343	-1.5956	.832162	29.50007	10.9176	.2159176E+02	-.2809106E+01
.79660000E+01	6.4927	437.1422	-2.0996	.785876	22.51049	8.0191	.2294116E+02	-.2954977E+01
.79670000E+01	5.2396	446.8505	-2.7963	.728745	15.08240	6.4660	.2441599E+02	-.3117497E+01
.79680000E+01	4.1742	457.8629	-3.7515	.669268	8.11459	4.7024	.2601021E+02	-.3296559E+01
.79690000E+01	3.2166	469.2102	-4.9868	.599708	1.59428	3.5424	.2770539E+02	-.3491497E+01
.79700000E+01	2.4369	479.8671	-6.7446	.468000	341.97795	2.7037	.2957700E+02	-.3695172E+01
.79710000E+01	1.8449	491.5686	-8.9509	.356626	332.19165	2.1096	.3161815E+02	-.3913563E+01
.79720000E+01	1.4270	503.0751	-11.7711	.257697	323.80196	1.8250	.3381978E+02	-.4141299E+01
.79730000E+01	1.1523	514.1080	-15.3938	.169965	318.10176	1.4095	.3599266E+02	-.4376519E+01
.79740000E+01	.9828	524.5386	-20.1716	.098844	316.78254	1.2174	.3809615E+02	-.4611561E+01
.79750000E+01	.8830	534.3491	-26.1729	.049149	330.90559	1.1083	.4002779E+02	-.4835800E+01
.79760000E+01	.8248	543.5711	-27.5557	.041900	29.76812	1.0675	.4180966E+02	-.5041503E+01
.79770000E+01	.7886	552.2983	-24.2862	.061051	51.26025	1.1300	.4342794E+02	-.5234791E+01
.79780000E+01	.7622	560.6123	-22.2196	.077086	59.11384	1.1679	.4489618E+02	-.5419387E+01
.79790000E+01	.7369	568.5936	-21.2852	.086247	61.63946	1.1868	.4617606E+02	-.5574165E+01
.79800000E+01	.7150	576.3094	-21.1316	.087743	62.27382	1.1928	.4718086E+02	-.5685034E+01
.79810000E+01	.6922	583.8127	-21.3963	.083194	62.16198	1.1815	.4789717E+02	-.5760726E+01
.79820000E+01	.6667	591.1436	-22.6490	.073719	60.00862	1.1598	.4834062E+02	-.5808138E+01
.79830000E+01	.6365	598.3273	-24.8591	.060841	56.83855	1.1309	.4857385E+02	-.5833169E+01
.79840000E+01	.6047	605.3807	-24.9777	.059764	56.61098	1.1280	.4859888E+02	-.5835859E+01

.7985000E+01	.6102	612.3261	-31.8149	.077490	96.97349	1.4367	.1710	.1681
.7990000E+01	.5975	619.1592	-30.8891	.069988	98.48007	1.4041	.1668	.1799
.7995000E+01	.5886	625.8881	-30.1763	.063068	100.77128	1.4196	.1633	.1876
.8000000E+01	.5833	632.3178	-31.3628	.026877	160.36752	1.0544	.1027	.1996
.8005000E+01	.5808	638.8697	-27.9018	.042242	165.66524	1.0564	.1041	.1994
.8010000E+01	.5803	645.4910	-26.9868	.039429	161.12662	1.1196	.1777	.2079
.8015000E+01	.5809	651.8867	-25.8147	.060279	156.00405	1.1464	.1759	.2139
.8020000E+01	.5817	658.1247	-22.1749	.077869	150.66217	1.1688	.1734	.2198
.8025000E+01	.5820	664.8331	-21.4284	.044869	155.29381	1.1892	.1719	.2176
.8030000E+01	.5811	671.4611	-20.9432	.049297	159.81466	1.1951	.1760	.2107
.8035000E+01	.5789	676.5786	-20.8149	.091675	154.91108	1.2088	.1867	.2000
.8040000E+01	.5750	682.6340	-20.8892	.090470	129.08730	1.2985	.1677	.1923
.8045000E+01	.5697	688.8573	-21.2114	.060979	123.41178	1.1965	.1669	.1847
.8050000E+01	.5633	694.6559	-21.7910	.091847	118.49866	1.1771	.1648	.1822
.8055000E+01	.5561	700.6368	-22.6565	.073635	118.77377	1.1598	.1659	.1841
.8060000E+01	.5488	706.6057	-24.8729	.060026	109.18897	1.1868	.1656	.1875
.8065000E+01	.5418	712.5688	-26.5915	.052648	105.19626	1.1116	.1655	.1877
.8070000E+01	.5358	718.5249	-27.8690	.048916	102.48932	1.0892	.1659	.1866
.8075000E+01	.5312	724.4757	-31.2961	.027289	102.68651	1.0380	.1656	.1858
.8080000E+01	.5285	730.4261	-36.8661	.014365	114.66529	1.0291	.1652	.1845
.8085000E+01	.5277	736.3740	-41.1571	.008743	102.38811	1.0177	.1651	.1844
.8090000E+01	.5291	742.3191	-34.3841	.019669	222.37458	1.0869	.1658	.1827
.8095000E+01	.5323	748.2614	-29.8440	.031196	227.55363	1.1665	.1650	.1819
.8100000E+01	.5372	754.2014	-26.9624	.044961	226.30838	1.1942	.1649	.1820
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.8110000E+01	.5499	766.0797	-23.4757	.067044	216.71155	1.1427	.1650	.1824
.8115000E+01	.5568	772.0241	-22.4267	.075667	214.00752	1.1436	.1650	.1823
.8120000E+01	.5632	777.9776	-21.7032	.082159	209.03420	1.1791	.1655	.1820
.8125000E+01	.5687	783.9467	-21.2524	.086572	203.89567	1.1896	.1660	.1819
.8130000E+01	.5729	789.9383	-21.0543	.088549	198.64793	1.1944	.1660	.1815
.8135000E+01	.5756	795.9609	-21.1069	.084665	193.32928	1.1931	.1670	.1806
.8140000E+01	.5769	802.0232	-21.4123	.068948	187.97261	1.1854	.1690	.1797
.8145000E+01	.5770	808.1341	-22.0101	.079368	182.61247	1.1724	.1705	.1781
.8150000E+01	.5762	814.3026	-22.9556	.071156	177.30099	1.1532	.1722	.1762
.8155000E+01	.5754	820.5370	-24.3549	.060578	172.13720	1.1290	.1741	.1738
.8160000E+01	.5751	826.8446	-26.4144	.047788	167.34356	1.1004	.1762	.1709
.8165000E+01	.5764	833.2316	-29.6011	.038109	163.59929	1.0685	.1785	.1678
.8170000E+01	.5800	839.7032	-35.3677	.017646	164.27967	1.0367	.1807	.1650
.8175000E+01	.5866	846.2630	-47.8078	.009078	245.91057	1.0082	.1834	.1625
.8180000E+01	.5968	852.9143	-84.4015	.019651	806.61649	1.0284	.1868	.1607
.8185000E+01	.6108	859.6606	-28.7593	.036478	806.89356	1.0757	.1917	.1596
.8190000E+01	.6282	866.5064	-25.5072	.058045	806.34180	1.1120	.1976	.1590
.8195000E+01	.6485	873.4595	-23.3796	.067768	297.32715	1.1454	.2047	.1587
.8200000E+01	.6706	880.5323	-21.9757	.079655	296.01681	1.1731	.2126	.1587
.8205000E+01	.6934	887.7402	-21.1455	.087646	286.72088	1.1921	.2203	.1585
.8210000E+01	.7158	895.1286	-20.8561	.090619	261.77084	1.1993	.2270	.1583
.8215000E+01	.7376	902.7099	-21.1691	.087617	277.66196	1.1918	.2314	.1577
.8220000E+01	.7596	910.5956	-22.2674	.077683	275.69133	1.1669	.2321	.1564
.8225000E+01	.7851	918.7257	-24.5206	.059829	279.99155	1.1264	.2301	.1544
.8230000E+01	.8212	927.2957	-27.7974	.040758	304.48650	1.0850	.2256	.1517
.8235000E+01	.8800	936.3861	-25.6957	.051906	699.58067	1.1495	.2267	.1504
.8240000E+01	.9807	945.9965	-19.8042	.102268	12.14616	1.2279	.2497	.1595
.8245000E+01	1.1499	956.1339	-15.1969	.173062	12.20946	1.4207	.2918	.1819
.8250000E+01	1.4206	966.8000	-11.6924	.240243	6.53536	1.7834	.3553	.2196
.8255000E+01	1.8274	978.0605	-8.9511	.356615	858.85355	2.1895	.3147	.1853
.8260000E+01	2.3965	989.4436	-6.7966	.457267	846.95666	2.6951	.3162	.1506
.8265000E+01	3.1458	1000.7198	-5.1220	.544581	839.89408	3.4899	.3066	.1271
.8270000E+01	4.0610	1011.5676	-3.8448	.642835	829.81819	4.3918	.2917	.1113
.8275000E+01	5.1171	1021.7286	-2.8895	.717010	819.98617	5.4674	.2709	.1012
.8280000E+01	6.2776	1031.0406	-2.1687	.777581	811.84140	7.4900	.2466	.0952
.8285000E+01	7.5056	1039.4583	-1.6714	.824942	804.47716	10.4254	.2219	.0904
.8290000E+01	8.7689	1047.0050	-1.2944	.861854	296.59543	13.4252	.1997	.0854
.8295000E+01	10.0482	1053.7510	-1.0217	.889028	890.09690	17.0229	.1770	.0785
.8300000E+01	11.3113	1059.7852	-.8179	.910028	884.35692	21.2284	.1585	.0700
.8305000E+01	12.5617	1065.1981	-.6676	.924617	879.29549	26.0325	.1425	.0624
.8310000E+01	13.7676	1070.0744	-.5532	.936297	874.63529	31.4131	.1287	.0559
.8315000E+01	14.9449	1074.4882	-.4655	.947015	870.96019	37.0253	.1167	.0502
.8320000E+01	16.1518	1078.5032	-.3974	.955279	866.45911	43.7171	.1065	.0457
.8325000E+01	17.2674	1082.1735	-.3438	.961156	863.18236	50.9913	.0978	.0418
.8330000E+01	18.3921	1085.5444	-.3009	.965950	859.96763	57.7874	.0898	.0385
.8335000E+01	19.4665	1088.6539	-.2642	.969619	857.03917	65.4587	.0830	.0357
.8340000E+01	20.5116	1091.5341	-.2378	.972999	854.30716	73.0566	.0770	.0332
.8345000E+01	21.5287	1094.2119	-.2142	.975639	851.76580	81.0981	.0719	.0309
.8350000E+01	22.5188	1096.7101	-.1945	.977641	849.39925	89.3568	.0670	.0289
.8355000E+01	23.4833	1099.0481	-.1777	.979747	847.17393	97.7981	.0628	.0272
.8360000E+01	24.4233	1101.2425	-.1634	.981367	845.08919	99.0000	.0591	.0256
.8365000E+01	25.3401	1103.3078	-.1510	.982760	843.12657	99.0000	.0556	.0241
.8370000E+01	26.2347	1105.2561	-.1402	.983987	841.27892	99.0000	.0526	.0228
.8375000E+01	27.1082	1107.0983	-.1307	.985061	839.52256	99.0000	.0497	.0216
.8380000E+01	27.9616	1108.8438	-.1224	.986010	837.86268	99.0000	.0472	.0205
.8385000E+01	28.7950	1110.5007	-.1149	.986859	836.28587	99.0000	.0448	.0195
.8390000E+01	29.6117	1112.0768	-.1083	.987611	834.78626	99.0000	.0427	.0186
.8395000E+01	30.4102	1113.5778	-.1023	.988293	833.35755	99.0000	.0407	.0177
.8400000E+01	31.1920	1115.0096	-.0969	.988911	831.99879	99.0000	.0388	.0169
.8405000E+01	31.9578	1116.3777	-.0919	.989478	830.69977	99.0000	.0371	.0162

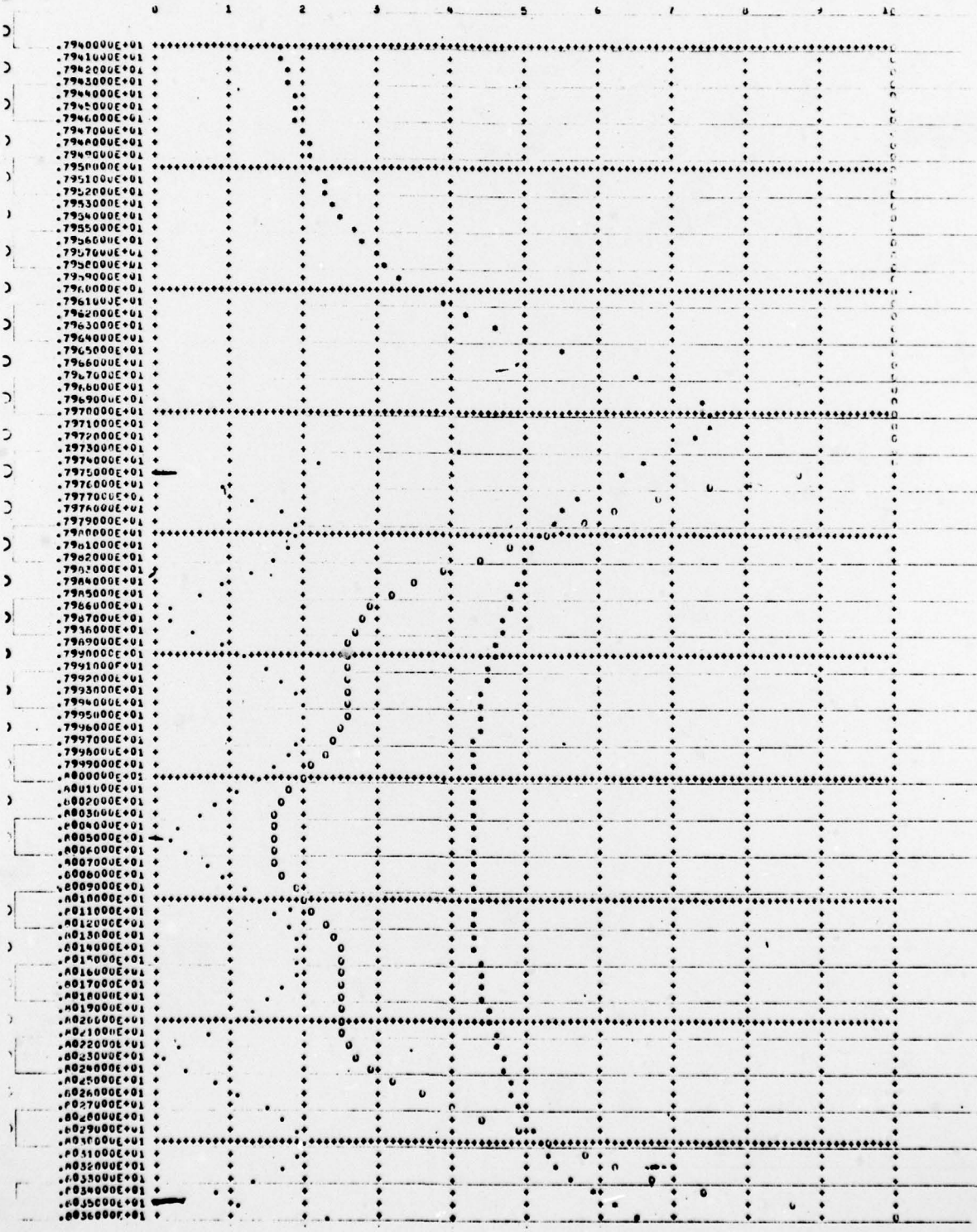
LOCK YOUNG FILTER
FILTER DESIGN PLOTS

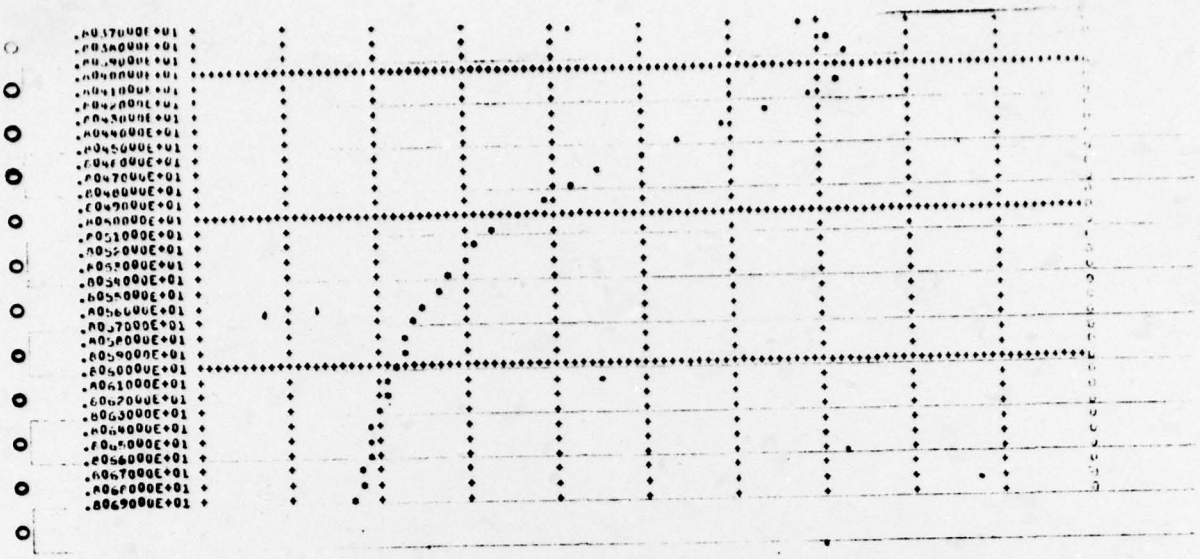
STANDING WAVE RATIO AND TIME DELAY VS FREQUENCY

SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 2 (TIME DELAY VS FREQUENCY) = +
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = 0

Y AXIS SCALE

PLOT	LOWER	CENTER	UPPER
1	.1000E+01	.1500E+01	.2000E+01
2	-.5000E+01	.2000E+02	.4500E+02
3	.4500E+00	.7000E+00	.9500E+00





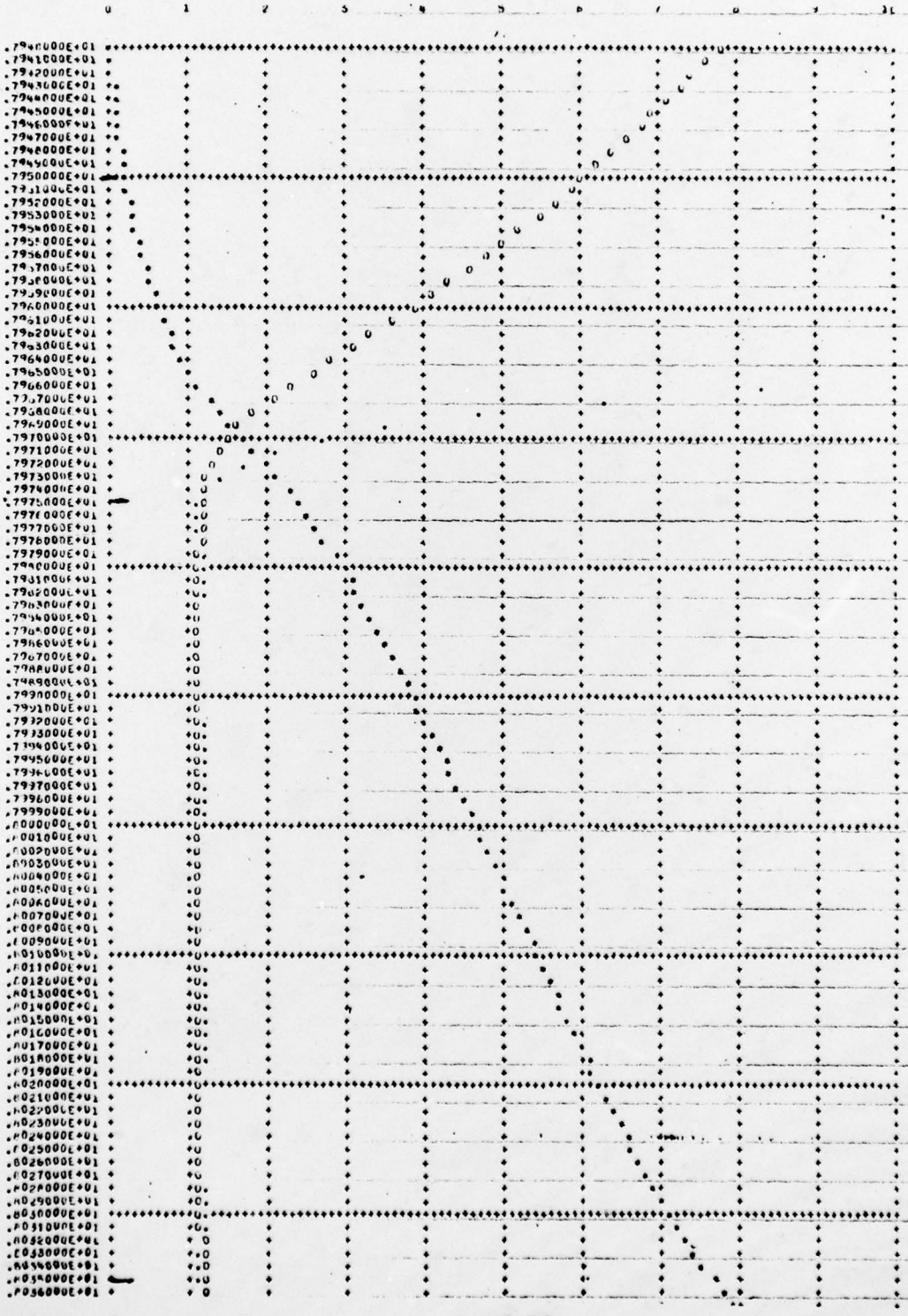
LOCK FOUND FILTER JULY 78
FILTER DESIGN PLOTS

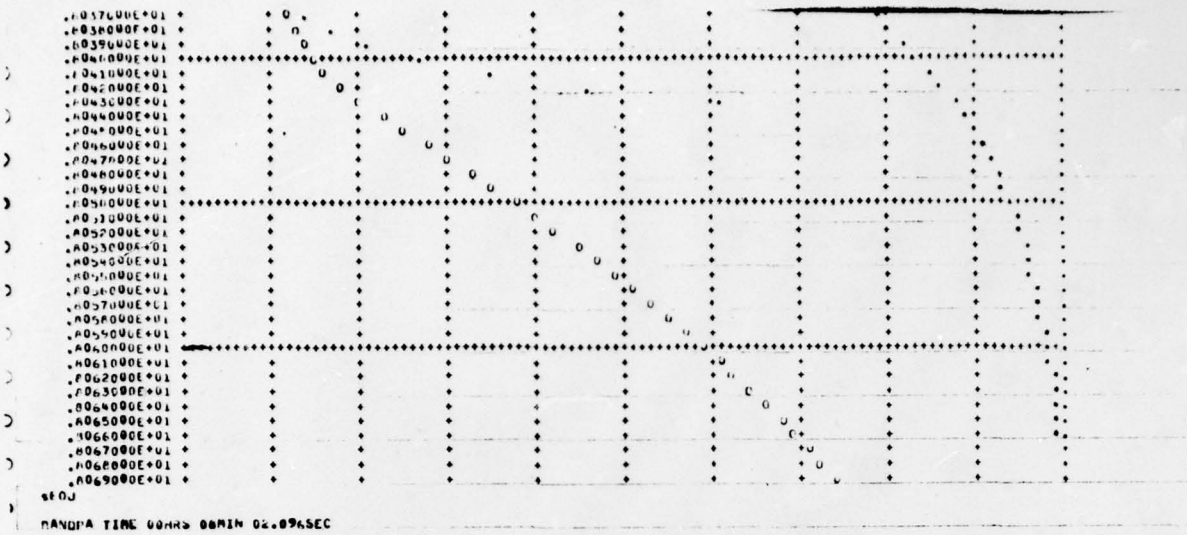
INSERTION LOSS AND INSERTION PHASE VS FREQUENCY

SYMBOL FOR GRAPH 1 (STANDING WAVE RATIO VS FREQUENCY) = *
SYMBOL FOR GRAPH 2 (INSERTION PHASE VS FREQUENCY) = @
SYMBOL FOR GRAPH 3 (INSERTION LOSS VS FREQUENCY) = 0

Y AXIS SCALE

PLOT	LOWER	CENTER	UPPER
1	.8000E+01	.8060E+01	.[illegible]
2	.3501E+05	.7302E+04	.1116E+04
3	-.5000E+01	.2040E+02	.[illegible]





END OF

RANDPA TIME 00HRS 00MIN 02.096SEC